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The Engineer

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A Fuel Research Station.

PUBLIC NOTICES

Civil Engineer Required by the GOVERNMENT of NIGERIA, to supervise the working of a ROTARY DRILL, for two tours, each of 18 to 24 months' service, with possible extension. Salary £800 per annum. Free first-class passages and quarters provided. Liberal leave in England on full salary.

Candidates, under 40, must be qualified Civil Engineers and have had experience in the working of rotary, preferably shot drills, and be competent to take full charge of drilling operations. A knowledge of geology is desirable, although not essential, but the person selected must be competent to keep records of geological strata passed through, to arrange cores in boxes in the correct sequence, and to prepare sections showing the exact point at which each stratum is met and passed through.

Apply at once, in writing, giving age and brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/Nigeria 10,937. 5507

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that J. TYLOR and SONS, Limited, of Oakleigh-road, New Southgate, London, N. 11, Engineers, and HERBERT TAYLOR WHITE, of 7, The Priors, Hampstead, London, N.W., Engineer, SEEK LEAVE to AMEND the SPECIFICATION for LETTERS PATENT No. 153,221, entitled "Improvements in the Cylinder Heads of Internal Combustion Engines."

Particulars of the proposed amendment were set forth in the Illustrated Official Journal (Patents) issued on the 29th June, 1921.

Any person or persons may give notice of opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
5470 H Comptroller-General.

THE

University of Liverpool.

SESSION 1921-22.

AUTUMN TERM BEGINS OCTOBER 6, 1921.

FACULTY OF ENGINEERING.

DEAN: Professor J. WEMYSS ANDERSON, M.Eng., M. Inst. C.E., M.I. Mech. E.

PROFESSORS AND LECTURERS.

ENGINEERING.
Harrison Professor—W. H. WATKINSON, M.Eng., M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Robert Rankin Professor of Engineering (Thermodynamics of Heat Engines)—G. E. SCHOLES, M.B.E., M.Sc., A.M.I.A.E.
John William Hughes Professor of Engineering (Strength of Materials)—W. MASON, D.Sc., Assoc. M. Inst. C.E., A.M.I. Mech. E.

MARINE ENGINEERING.
Professors and Lecturers in Naval Architecture and Engineering.

ELECTRICAL ENGINEERING.
David Jardine Professor—E. W. MARCHANT, D.Sc., M.I.E.E.
Lecturer in Electrical Machinery—F. J. TEAGO, M.Sc., M.I.E.E.
Lecturer in Municipal Electrical Engineering—Vacant.

CIVIL ENGINEERING.
Professor S. W. PERROTT, M.A.I., M. Inst. C.E., Lecturer in Railway Engineering—Associate Professor Sir J. A. F. ASPINALL, M. Eng., M. Inst. C.E., M.I. Mech. E., M.I. and S.I.
Lecturer in Municipal Engineering—Associate Professor J. A. BRODIE, M. Eng., P. Inst. C.E., M.I. Mech.E.
Lecturer in Dock and Harbour Engineering—Associate Professor T. R. WILTON, M.A., Assoc. M. Inst. C.E., M. Cons. E.

NAVAL ARCHITECTURE.
Alexander Elder Professor—T. B. ABELL, O.B.E., M.Eng., R.C.N.C., Ret., M. Inst. N.A.

ENGINEERING DESIGN AND DRAWING.
Professor J. WEMYSS ANDERSON, M.Eng., M. Inst. C.E., M.I. Mech. E.

REFRIGERATION.
John William Hughes Professor of Engineering—J. WEMYSS ANDERSON, M.Eng., M. Inst. C.E., M.I. Mech. E.

METALLURGY.
Henry Bell Worthey Professor—C. O. BANNISTER, Assoc. R.S.M., F.I.C.

MATHEMATICS.
Professor F. S. CAREY, M.A.

APPLIED MATHEMATICS.
Professor J. PROUDMAN, M.A., D.Sc.

MATHEMATICAL HYDROGRAPHY.
Lecturer—R. O. STREET, M.A., M.Sc.

PHYSICS.
Lyon Jones Professor—L. R. WILBERFORCE, M.A.
Senior Lecturer—J. RICE, M.A.

CHEMISTRY.
Grant Professor of Inorganic Chemistry—E. C. C. BALY, C.B.E., M.Sc., F.R.S.
Senior Lecturer in Analytical Chemistry—J. SMEATH THOMAS, D.Sc.

GEOLOGY.
George Herdman Professor—P. G. H. BOSWELL, O.B.E., D.Sc., M. Inst. M.M., F.G.S.

The Prospectus of the Faculty may be obtained on application to the undersigned.

EDWARD CAREY,
5366 Registrar.

County Borough of East Ham
EDUCATION COMMITTEE.

EAST HAM TECHNICAL COLLEGE: EVENING CLASSES.

Principal: W. H. BARKER, B.Sc., F.C.S.

REQUIRED, TEACHERS for—
(a) MECHANICS and HEAT, on Tuesday and Friday evenings, from 7 to 9.30 o'clock.
(b) MANUAL TRAINING METALWORK, for the City and Guilds of London Institute Examinations, on Thursday and Friday evenings, from 7 to 9.30 o'clock.

Preference will be given to candidates who have had experience in Teaching. A form of application, together with the conditions of appointment and scale of salaries, may be obtained from the undersigned or from the Principal, Technical College, East Ham, E. 6.

(Signed) F. R. THOMPSON,
Secretary.

27th June, 1921.
Education Office,
Town Hall, East Ham, E. 6. 5486

Birmingham Municipal Technical School.

WANTED, MECHANICAL ENGINEER (age 25 to 35), to Take Charge of Heating, Ventilating and Electric Lighting Plant, including Babcock Boiler, Gas Engines and Electric Generators.—For full particulars, apply SECRETARY, Municipal Technical School, Suffolk-street, Birmingham. 5496

PUBLIC NOTICES

The University of Liverpool.

FACULTY OF ENGINEERING.

APPLICATIONS are INVITED for the MUNITIONS COMMITTEE FELLOWSHIP, value £250, preference being given to Graduates in Engineering of the University of Liverpool.

Applications should be addressed to the REGISTRAR, the University of Liverpool, and be received by him not later than Friday, July 15th, 1921, from whom further particulars may be obtained. 5488

The City and Guilds (Engineering) College.

ELECTRICAL ENGINEERING DEPARTMENT.

The Delegacy are prepared to receive APPLICATIONS for a POST as DEMONSTRATOR in ELECTRICAL ENGINEERING. Salary commencing at £300.

Applications, stating age and giving full particulars of education, training and experience, should be addressed in the first instance to Professor T. MATHER, F.R.S., City and Guilds (Engineering) College, South Kensington, S.W. 7, before July 22nd, 1921. 5446

Bombay, Baroda, and Central India Railway Company.

The Directors are prepared to receive up to Noon on Wednesday, 27th July, TENDERS for the SUPPLY of—

CLASS A.
1. COPPER FIRE-BOX PLATES.
2. STEEL BOILER TUBES, FLUE TUBES, and STEAM PIPES.
3. LAMINATED BEARING SPRINGS.
4. WHEELS and AXLES.

CLASS B.
1. CAST STEEL WHEEL CENTRES for LOCOMOTIVES.
2. AXLES for LOCOMOTIVES.
3. TYRES for LOCOMOTIVES.
4. AXLE-BOXES for WAGONS.
5. BRASS BOILER TUBES.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment as follows:—

For Class A, 20s. each, and for Class B, 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France,
Westminster, S.W. 1.
4.7.21. 5484

West Kent Main Sewerage Board.

EXTENSION OF MAIN OUTFALL WORKS.

TENDERS are INVITED for the CONSTRUCTION of REINFORCED CONCRETE RIVER WHARF, BRIDGE, and other WORKS at Long Reach, Dartford.

Drawings may be seen at the offices of the Consulting Engineer, Sidney R. Lowcock, M. Inst. C.E., 6, Queen Anne's-gate, Westminster, or at the offices of the Board, and a copy of the conditions of contract, specifications, bill of quantities, form of Tender, &c., may be obtained from the undersigned upon payment of a deposit of Five Pounds, which will be returned upon receipt of a bona fide Tender, not afterwards withdrawn.

Tenders, sealed and endorsed "Contract No. 2," must be delivered to me, at the offices of the Board, on or before Twelve Noon, Saturday, 23rd July next.

The Board do not bind themselves to accept the lowest or any Tender.

ARTHUR B. COOMBER,
Secretary.

Offices of the Board,
Park House, Bromley, Kent. 5516

PUBLIC NOTICES

Brownhills Urban District Council.

BROWNHILLS, &c., SEWERAGE, PUMPING MACHINERY.

TO MANUFACTURERS OF OIL ENGINES AND OF STEREOPHAGUS CENTRIFUGAL PUMPS.

The Brownhills Urban District Council invite TENDERS for the MANUFACTURE, DELIVERY, ERECTION, and SETTING TO WORK of TWO OIL ENGINES and FOUR STEREOPHAGUS PUMPS (of a combined capacity of 46,000 gallons per hour), also of other MACHINERY, in accordance with the specification and drawing prepared by their Consulting Engineer, Mr. Robert Green, M. Inst. C.E., 37, Waterloo-street, Birmingham, from whom copies can be obtained on and after Monday, the 11th July, 1921, upon the payment of Three Guineas, which will be returned only to those manufacturers who submit a bona fide Tender not subsequently withdrawn.

These documents will only be issued to bona fide manufacturers of oil engines and of stereophagus pumps respectively.

Sealed Tenders, addressed to the undersigned, to be delivered before Twelve Noon on Wednesday, the 3rd August, 1921.

The Council does not bind itself to accept the lowest or any Tender submitted.

By Order,
W. FRED HALL,
Solicitor and Clerk to the Council.
21, Park-street, Walsall,
1st July, 1921. 5478

London County Council.

TENDERS are INVITED for the SUPPLY of 2000 TRAILING WHEEL TYRES for Electric Tramcars.

The form of Tender may be obtained from the General Manager, London County Council Tramways, 23, Belvedere-road, Lambeth, S.E. 1.

No Tender received at the County Hall, Spring-gardens, S.W., after Twelve Noon on Tuesday, 19th July, 1921, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
5482 Clerk of the London County Council.

Madras and Southern Mahratta Railway Co., Ltd.

The Directors are prepared to receive TENDERS for—

WROUGHT IRON or MILD STEEL PIPING and FITTINGS, &c.,

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, the 26th July, 1921, marked "Tender for W.I. or M.S. Piping, &c."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road,
Westminster, S.W. 1.
5th July, 1921. 5510

BOILER WANTED.

The Lurgan Urban District Council are open to receive TENDERS for SUPPLYING and ERECTING at their Gasworks a WATER-TUBE BOILER fitted with CHAIN GRATE STOKER and FORCED DRAUGHT FAN.

Particulars and forms of Tender can be had on application from the Gas Manager, Gasworks, Lurgan.

Sealed Tenders to be submitted and lodged with the undersigned on or before 18th July next.

F. W. POLLOCK,
5450 Town Clerk.

PUBLIC NOTICES

Maidenhead Union.

TO HEATING ENGINEERS, &c.

The Guardians of the Poor of the Maidenhead Union, Berkshire, invite TENDERS from persons willing to contract for the provision of a new SECTIONAL BOILER and addition PIPE WORK and RADIATORS.

A copy of the form of Tender and envelope and of the bill of quantities may be obtained from the Consulting Engineers, Messrs. Dolby and Williamson, 8, Prince's-street, Westminster, S.W. 1, upon depositing the sum of £2, which will be returned on receipt of a bona fide Tender, and the plans and specification and conditions of contract inspected either there or at the Master's Office at the Poor Law Institution, St. Mark's-road, Maidenhead, from the 11th up to the 16th July, 1921, both inclusive.

Tenders must be enclosed and sealed in the special envelope and delivered at the undermentioned offices not later than 10 a.m. on the 25th July, 1921; they will be opened at a meeting of the Guardians. Each person tendering, must be prepared to give satisfactory references and sureties if required.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
T. W. STUCHBERY,
Clerk.

Union Offices,
1, Park-street, Maidenhead. 5515

The Great Indian Peninsula Railway Company.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely:—

No.		Fee for Specification.
1.	STEEL WORK FOR BRIDGES (Oil-vant Road Overbridge)	£1
2.	SPARE PARTS OF CARRIAGES AND WAGONS (Axle Guards, &c.)	10s.
3.	DRESSED WAGON COVERS	£1
4.	GALVANISED STAMPED STEEL MORTAR PANS	5s.
5.	MANTLES FOR LAMPS	5s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Steel Work for Bridges," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 19th July, 1921.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Copthall-avenue, E.C. 2,
London, 6th July, 1921. 5514

City of Birmingham Electric Supply Department.

STEAM-DRIVEN ELECTRIC GENERATING PLANT FOR SALE.

The undermentioned PLANT installed at the Corporation Electric Generating Station, Summer-lane, Birmingham, is FOR SALE and IMMEDIATE REMOVAL:—

THREE 500 K.W. Bellias and Morcom British Westinghouse Engine-driven ALTERNATORS, complete with ONE SURFACE CONDENSER and ONE Motor-driven AIR PUMP. Each engine is of the triple-expansion type, running at 250 r.p.m., with steam supplied at 160 lb. per square inch superheated to 532 deg. F.

Each alternator is of the three-phase 25-period type generating at a voltage of 5500 volts between phases.

The three engines exhaust into a common surface condenser having 4200 square feet of cooling surface and manufactured by Messrs. Bellias and Morcom. The three-throw Edward type air pump, also manufactured by Messrs. Bellias and Morcom, runs at 80 r.p.m. and is driven through spur gearing by a 25 H.P. Dick-Kerr 460-volt D.C. motor.

The plant, which was installed in 1906, is in first-class condition and can be inspected or seen on load by appointment.

The three sets and condenser form one complete unit of generating plant fitted with platforms, ladders and hand rails.

The dismantling and removal of the plant to be carried out by the purchaser. The use of an overhead travelling crane will be allowed free, the purchaser to accept all responsibility for any damage done to buildings or other plant in the Station.

Permits to inspect can be obtained on application to the undersigned, to whom all offers should be addressed.

E. J. JENNINGS,
Secretary.

14, Dale End, Birmingham,
28th June, 1921. 5436

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PUBLIC NOTICES

South Shields Corporation.
ELECTRICITY DEPARTMENT.

FOR SALE, about 50 TONS of "Universal Joist" SHEET STEEL PILES, complete with Clutches (British Steel Piling Co.'s Patent), consisting of the following material :—

70 Piles, 15in. by 5in., complete with Single Clutch, each 25ft. long.
2 Piles, 14in. by 5in., complete with Single Clutch, each 12ft. long.
4 Corner Piles bent to right angle, complete with Clutch, each 25ft. long.
2 Right-angle Compound Junction Piles with Clutches complete, each 25ft. long.

The piles offered are in good condition and could be used, if necessary, on constructional work, serving as heavy stanchions or floor joists as required. Further particulars may be obtained on application to the undersigned, who will be pleased to receive best offers for the whole or part, free on rail South Shields.

EDGAR MOXON, A.M.I.E.E.,
Borough Electrical Engineer.
Electricity Offices,
Victoria-terrace, South Shields. 5476

FOR SALE.

The Morley Corporation Electricity Committee
have FOR SALE the following PLANT, all in good working order :—

ONE Worthington Vertical Boiler FEED PUMP and ONE Holden and Brooke INJECTOR.
TWO Horizontal Cross Compound Corliss Valve ENGINES with Single-phase, 2000-Volt, 50-Period ALTERNATOR fitted on crank shaft, rated output 120 K.W., 100 rev. per minute; the engines are by Follett and Wigsell and the Alternators by Electric Construction Company.
ONE Vertical Belliss and Morcom Enclosed High-speed ENGINE, direct coupled to Leeds and London ALTERNATOR and EXCITER, 2000 volts, 60 periods, rated output 30 K.W. This is a very compact plant and suitable for a mill or private installation.
Also a Large Quantity of various sizes of STEEL and CAST IRON PIPES, VALVES, and SHAFTING.

The whole of the plant can be inspected at the Corporation Electricity Works by arrangement with Mr. J. E. Ellis, the Borough Electrical Engineer, and any further particulars can be obtained from him. All Tenders to be addressed to the TOWN CLERK, Town Hall, Morley. 5474

South Staffordshire Water-Works Company.
CIVIL ENGINEERING ASSISTANT.

The above Company REQUIRE AT ONCE the SERVICES of a CIVIL ENGINEERING ASSISTANT about 30 years of age, with technical and practical training and conversant with the work of large Water-works Undertakings. Preference will be given to applicants who are good draughtsmen with experience of parliamentary work and who have had actual experience of Main Laying, Reservoir Construction, Sinking of Large Bore-holes, are competent Surveyors and Levellers.

Applicants should be associate members of the Institution of Civil Engineers.

Applications, giving age, details of experience, salary required, and enclosing copies of recent testimonials, must be addressed to the undersigned.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.
28A, Paradise-street, Birmingham. 5475

SITUATIONS OPEN

WANTED, an ASSISTANT BLAST-FURNACE MANAGER for the East; one who has had a first-class training as Chemist with at least two years' experience as Assistant Blast-furnace Manager or such position on up-to-date blast-furnace plant. The successful applicant will be sent for about six months' training on latest American plants in U.S.A., and will, if services satisfactory, be appointed manager of large plant in East within three years.—Address, stating age and full particulars of education and training, 5490, The Engineer Office. 5490 A

WANTED by London Company, an ENGINEER or CHEMIST, with full knowledge of Oil Extraction by Solvents; must have practical experience of Extraction Plants. No others need apply. Able to sell, also help in selling other Chemical Plant if required. State age, training, experience and salary required. All applications treated in strictest confidence.—Address, P3594, The Engineer Office. P3594 A

WANTED for Contracting Company, Bombay, Up-to-date and fully experienced ENGINEER or ARCHITECT for executive work in Building Construction. Salary Rs. 1200 to 1800 per mensem, according to qualification.—Address, P3562, The Engineer Office. P3562 A

WANTED for Indian Galvanising Works, an ENGINEER (unmarried) as ASSISTANT MANAGER, with practical experience in the Manufacture of Galvanised Tanks, Buckets, Hollow-ware, and Light and Heavy Galvanised Work generally.—Write, stating age, experience, and salary required, to Z. Y. 851, c/o Deacon's, Leadenhall-street, London, E.C. 3. 5512 A

CHARGE HANDS (TWO) REQUIRED for Power Station in India on three years' agreement.—Applicants to send full particulars, including age, mechanical and electrical experience, and wages required.—Address, 5524, The Engineer Office. 5524 A

COX and DANKS, Iron and Steel Merchants, 108, Regent-street, W.1, have VACANCY for a first-class SALESMAN on their staff. The position is only open to a first-class man with good connection —Apply in writing, stating experience and salary required. 5506 A

ENGINEER WANTED, Midland Area, to Take Charge of moderate-size works producing high-class Speciality (not mass production); good technical qualifications and Engineering Experience. Age about 30-35. Salary £400 per annum, with prospects. —Address, P3577, The Engineer Office. P3577 A

LIVE, Energetic, and Experienced SALESMEN, able to induce business in Tubes, Fittings, Valves, &c., in East London, West London, and South Coast respectively, REQUIRED by large manufacturers.—Write, giving full details experience, age, salary, &c., to "W. W.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 5526 A

MESSRS. RANSOMES and RAPIER are REQUIRING the SERVICES of a STOREKEEPER to Take Charge of their General Stores at Waterside Works, Ipswich. Applicants should state past experience, age, salary required, &c. 5520 A

NORTONS (Tividale), Ltd., Invite APPLICATIONS from gentlemen of influence with Collieries, Gasworks and Architects, for POSITION as REPRESENTATIVE in South Wales for their manufactures, viz., Colliery Screening Plants, Head Gears, Pithead Pulleys, Electric Haulage Gears, Machine-moulded Gear Wheels, Coke Screens and Conveyors, Steel Buildings, Bridges, &c. Remuneration mainly by commission.

The company have one of the best-equipped works and an established reputation for the above manufactures, and require a first-class, energetic representative.—Send full particulars to NORTONS (Tividale), Ltd., Hoels Works, Tipton. 5499 A

PRODUCTION ENGINEER.—Practical and Technical MAN WANTED, with experience of getting maximum output on mass production methods. Capable of taking charge of all statistics of progress and must have held similar position.—Address, stating age, qualifications, and salary expected, 5448, The Engineer Office. 5448 A

SITUATIONS OPEN (continued)

REPRESENTATIVE WANTED, with Thorough knowledge of the requirements of English Mines and Quarries.—Write, stating experience, and terms for whole or part-time, to "SCREENS," Box 340, Selfs' Advertising Offices, Fleet-street, E.C. 4. 5493 A

REQUIRED for London, MAN as TRAVELLER, with sound practical knowledge of Hot Water Installations, domestic and general; must be good salesman, progressive position. State experience, age and salary required.—Address, P3592, The Engineer Office. P3592 A

YOUNG MECHANICAL ENGINEER, Who Has Had college training and actual shop experience, is REQUIRED for Research Work with Mechanical Engineers. Only applications stating fully detailed particulars of training, career, age and wage, will be considered.—Address, 5442, The Engineer Office. 5442 A

WANTED for London, 'E.C. District, JUNIOR DRAUGHTSMAN, with experience in Detailing Electric Cranes and Hoisting Machinery. State age, experience, and salary required.—Z. F. 888, c/o Deacon's, Leadenhall-street, E.C. 3. 5527 A

DESIGNER WANTED, for Two or Four-stroke High-compression Oil Engines of the Cold starting type; must have had first-rate experience on this type of engine, and be able to prepare thoroughly efficient and satisfactory designs.—Address, 5503, The Engineer Office. 5503 A

DRAUGHTSMAN WANTED by a Midland Firm for Constructional Steel Work; one who has had special training in this direction and is quick at designing, detailing, and taking out quantities. Must be a rapid and accurate worker and capable of taking charge of departmental drawing-office. For the right man this post has good prospects.—Address, stating age, experience, and salary required, also give references, 5522, The Engineer Office. 5522 A

FIRST-CLASS RAILWAY CARRIAGE DRAUGHTSMAN WANTED.—Applicants should state age, experience and salary required, to LEEDS FORGE CO., Ltd., Carriage Works, Newlay, Leeds. 5504 A

REQUIRED, LEADING DRAUGHTSMAN, Experienced in Air and Gas Compressors, capable of Designing.—State full particulars of previous experience and salary expected to Box G. 556, c.o. Dawson's, 121, Cannon-street, E.C. 4. 5509 A

FOREMAN REQUIRED for Works, about 100 hands, East London. Experienced all classes Tanks, Cylinders and General Plating Work, riveted and welded; must have thorough control over men and capable of dealing with large output on rapid and economical basis; permanency.—State age, experience and references, with salary required, to Box "E. V. X.," c.o. Davies and Co., 95, Bishopsgate, London, E.C. 2. 5483 A

SITUATIONS WANTED

APPOINTMENT REQUIRED as COMMERCIAL MANAGER or COST ACCOUNTANT. Long experience in engineering business. Sound knowledge of accountancy, costing, and company and general mercantile law. Good organiser, energetic and reliable. 11 years present situation, 37 years of age. Please state salary and particulars of position offered.—Address, P3621, The Engineer Office. P3621 B

ASSISTANT ENGINEER OR JUNIOR DRAUGHTSMAN.—YOUNG MAN (23) SEEKS SITUATION as above; 9 years' engineering experience, 4 years' technical schooling.—Address, P3623, The Engineer Office. P3623 B

BUYER OF ENGINEERING SUPPLIES.—MANAGER of Large Purchasing Organisation, about terminating special engagement, DESIRES to NEGOTIATE NEW APPOINTMENT. Has wide knowledge of markets for all materials, is a keen departmental organiser, and accustomed to handling large contracts. —Write Z. Y. 295, c/o Deacon's, Leadenhall-street, E.C. 3. 5508 B

CHEMIST, with over 5 Years' General Analytical experience, public analysts and works, 2 years Army (R.E., Gas), age 25, SEEKS POSITION, any capacity; disengaged through slackness of trade; moderate salary accepted.
Apply, CHEMIST, c/o, W. H. Smith and Sons, 70, Sankey-street, Warrington, Lancs. P3570 B

CIVIL ENGINEER, B.Sc., A.M. Inst. C.E. (43), twenty years at home and abroad, railways, buildings, roads, bridges, workshops, DESIRES EMPLOYMENT at home. Moderate salary with prospects.—Address, P3614, The Engineer Office. P3614 B

CONSTRUCTIONAL and MECHANICAL ENGINEER OPEN to ENGAGEMENT as Manager, Resident or Works Engineer, overhead efficiency reconstruction, lay-outs, and extensions; 25 years' experience. Full details on application.—Address, P3611, The Engineer Office. P3611 B

DIE CASTING SPECIALIST, with Wide Experience in designing and manufacturing of all classes of hand and pressure dies and production by up-to-date methods in zinc base, aluni, &c., SEEKS POSITION. —Address, P3605, The Engineer Office. P3605 B

ENGINEER, Aged 44, A.M.I.C.E., SEEKS RESPONSIBLE POST in engineer's office or works as Departmental Manager or Chief Assistant; varied business experience in finance, correspondence, secretarial, accountancy, costs and progress departments, &c.; knowledge German.—Address, P3579, The Engineer Office. P3579 B

ENGINEER, A.M. Inst. C.E., OPEN for ENGAGEMENT; municipal, structural steel and bridges, railways, plants, design and construction; age 32; salary £7.—Address, 5505, The Engineer Office. 5505 B

ENGINEER, A.M.I.C.E., SEEKS POSITION with progressive firm; first-class experience in metallurgy, furnace and gas producer design, gas and coke making, steel structural work, building construction; also in commercial work and export. Knowledge of French and good draughtsman.—Address, P3588, The Engineer Office. P3588 B

ENGINEER DESIRES POSITION of TRUST to take control of plants, woodworking, pumping, refrigerating, dairy, hydraulic, mining, contractors' plant, general engineering work or lay-out, and erect new plant.—Address, P3624, The Engineer Office. P3624 B

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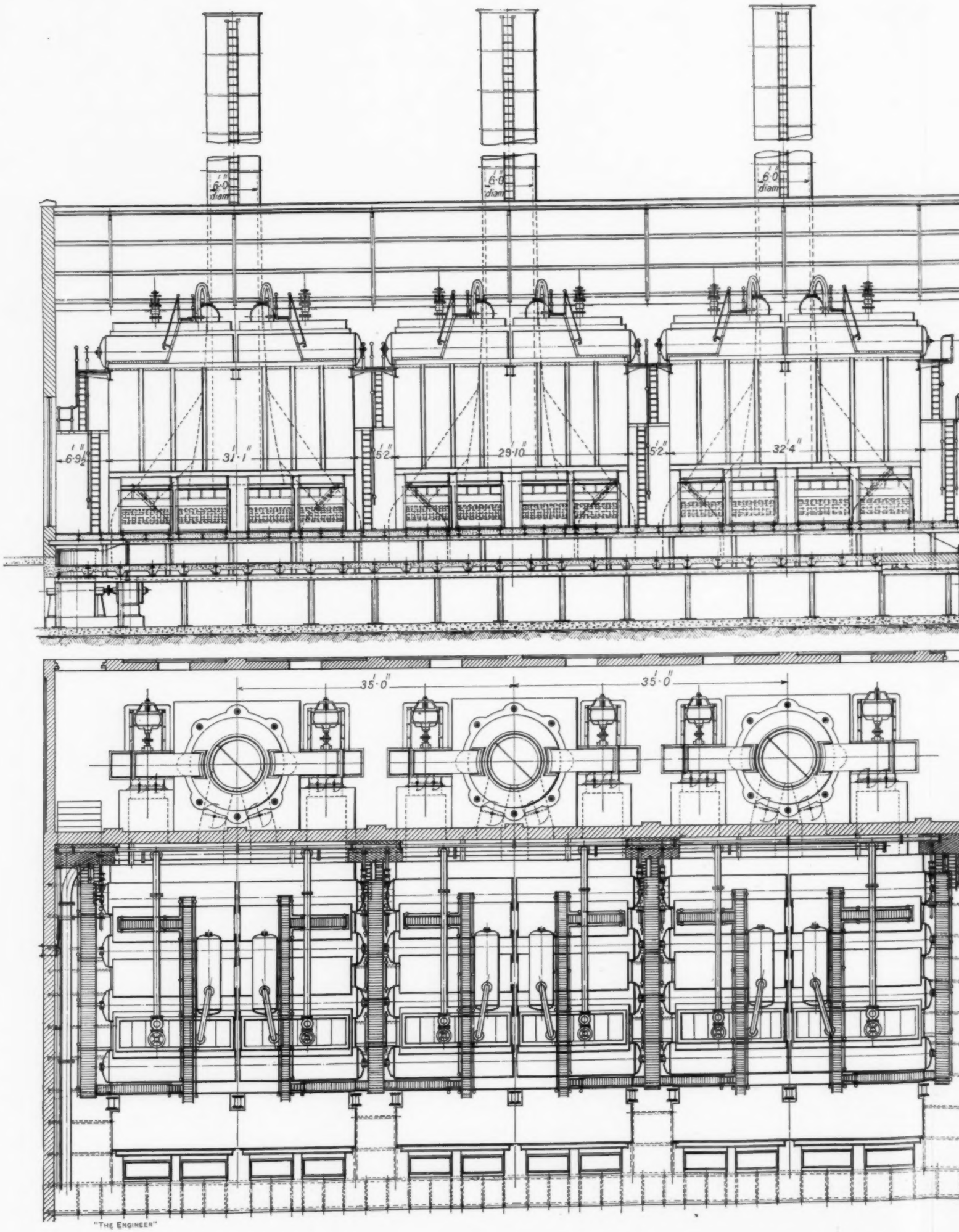

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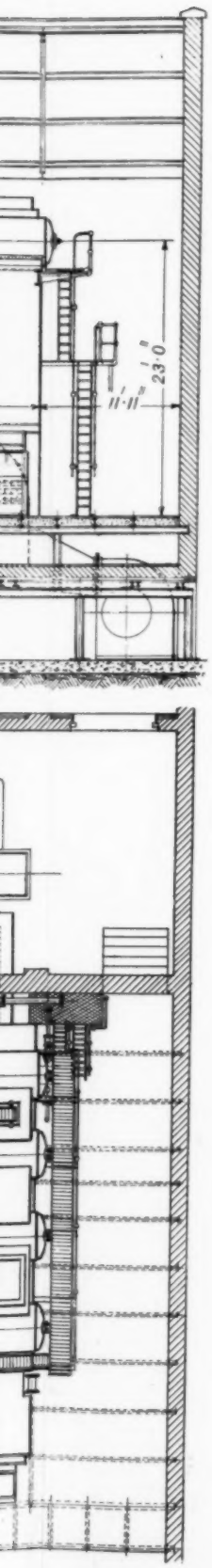
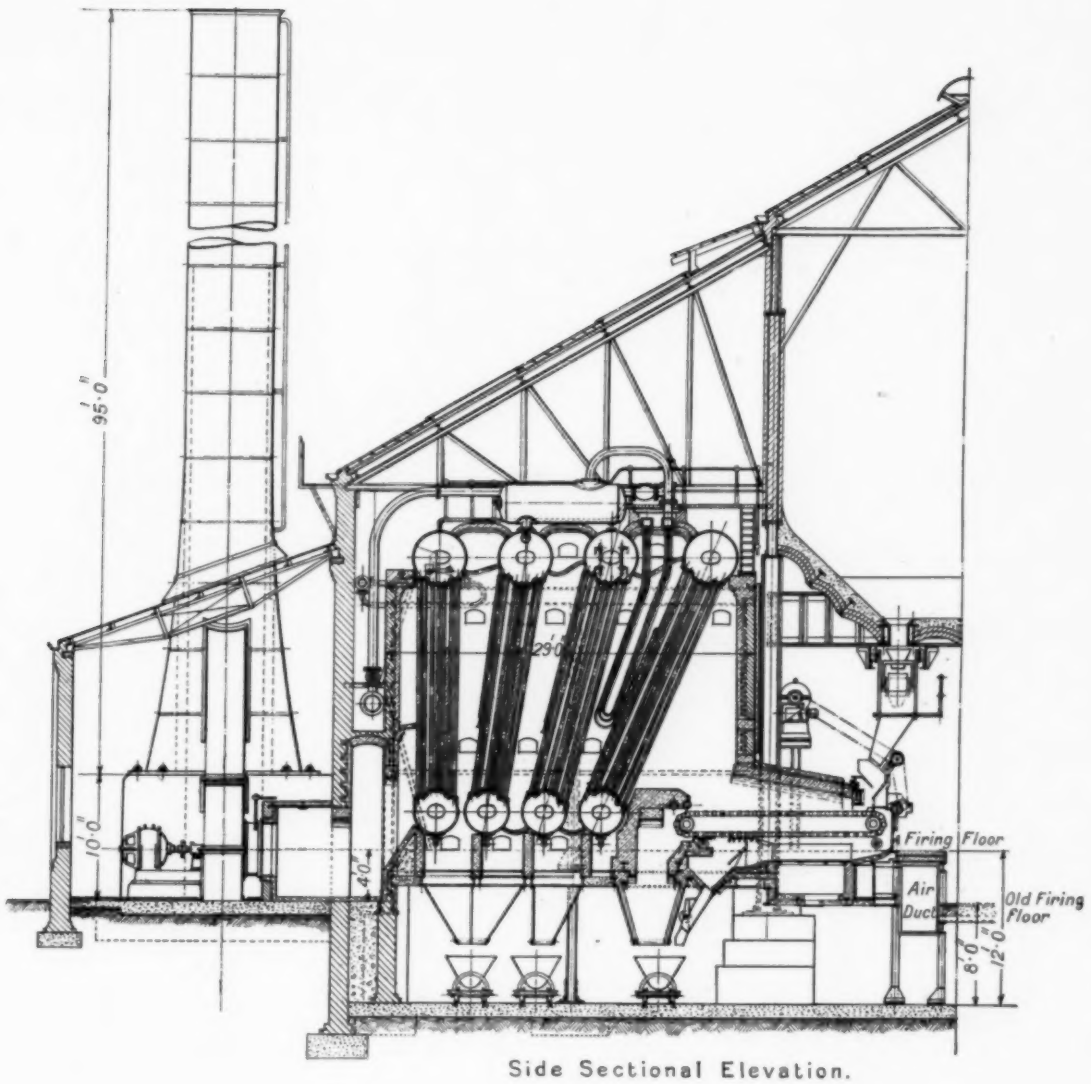
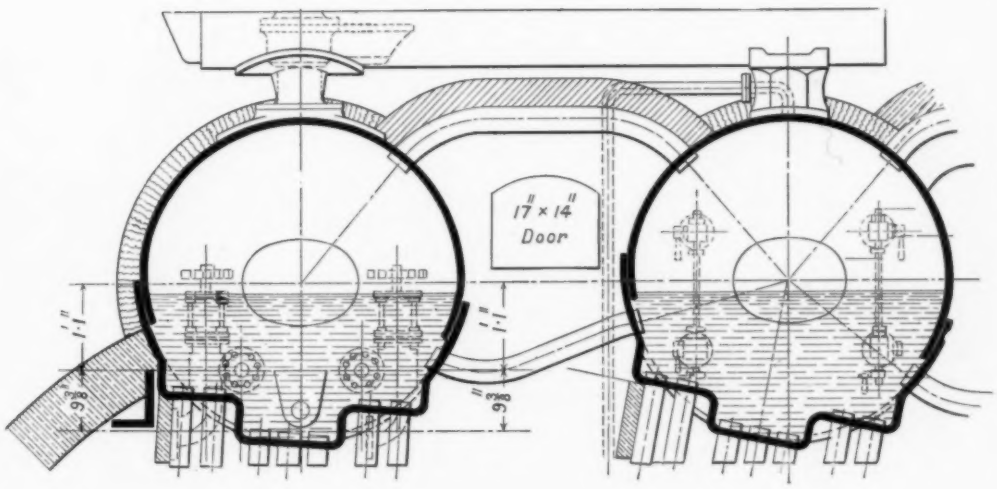




Side Sectional Elevation.



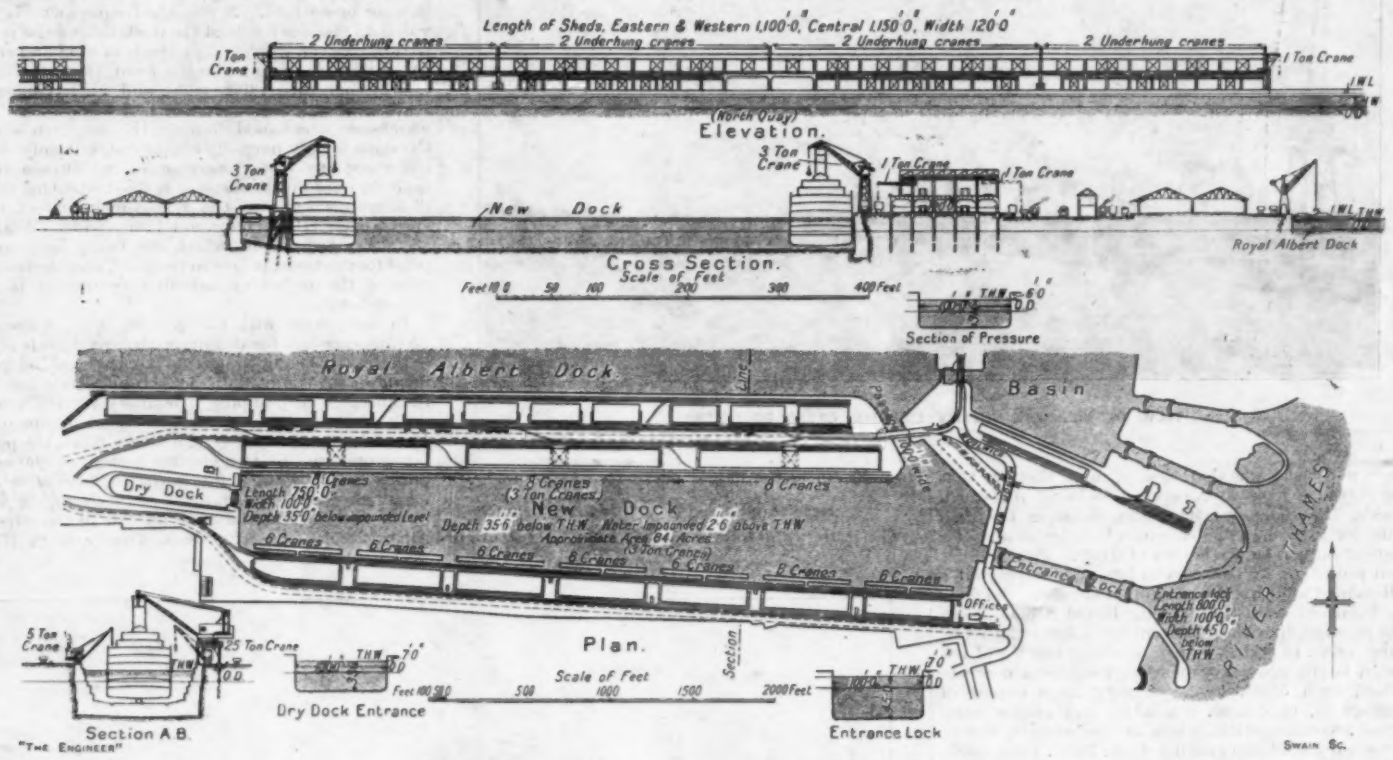
Section Through Steam Drums

Port of London.

OPENING OF NEW ALBERT DOCK EXTENSION.

BEFORE the advent of the Port of London Authority when the docks were in different ownership, there is no doubt that the facilities provided for shipping had failed to keep pace with the increasing dimensions of merchant vessels, and it is not perhaps too much to say that the future development of the Port of London and its maintenance as the world's great shipping centre were by no means assured.

One of the first acts of the Port Authority after its constitution was to lay plans for improvement schemes of considerable magnitude. The improvements extended to practically every part of the dock estate between the London docks and Tilbury, and entailed an expenditure of many millions. Considerable progress has now been made with the carrying out of these development schemes, and works are now in hand at the London Docks, West India Docks, Millwall Docks, Surrey Commercial Docks, Royal Victoria Dock at Tilbury—where the new cargo jetty has just been completed—and at the Royal Albert Dock. The most important of the works which have been carried out during the past few years is the extension to the Royal Albert Dock, which is to be opened by the King to-day, and an account of these large-scale works, with the general features of which readers of THE ENGINEER will probably be familiar, will be opportune at this time. The illustrations which appear in the present issue and the accompanying plan will indicate the character of the works which have made so material an addition to the facilities for big ships trading to the port of London. This work, however, by no means exhausts the programme of the Port Authority with regard to such schemes for the preparatory work for a new lock at the West India Docks to admit vessels up to 20,000 tons, a turning basin communicating with the whole of the West India and Millwall docks system, a large dry dock and an impounding installation to give an increased depth of water, has just been carried out.



PLAN AND CROSS SECTION OF NEW DOCK AND PROFILE OF SHEDS

The new Albert Dock works have been in hand for a period of ten years, and their execution has absorbed a considerable percentage of the £10,000,000 which have been expended by the Port of London Authority since it came into existence in the year 1909. Although the dock has only now been formally opened, it has been in partial use for some time past, and during the war period some of the warehouse accommodation was pressed into service at a time when congestion at the Port of London had reached a somewhat acute stage. The engineering scheme for the works was prepared by Mr. Frederick Palmer, who was at that time the chief engineer of the Authority, but has been carried out, with certain modifications in plans, by the present chief engineer, Mr. C. R. S. Kirkpatrick, and during the whole period of execution Mr. Asa Binns has acted as resident engineer.

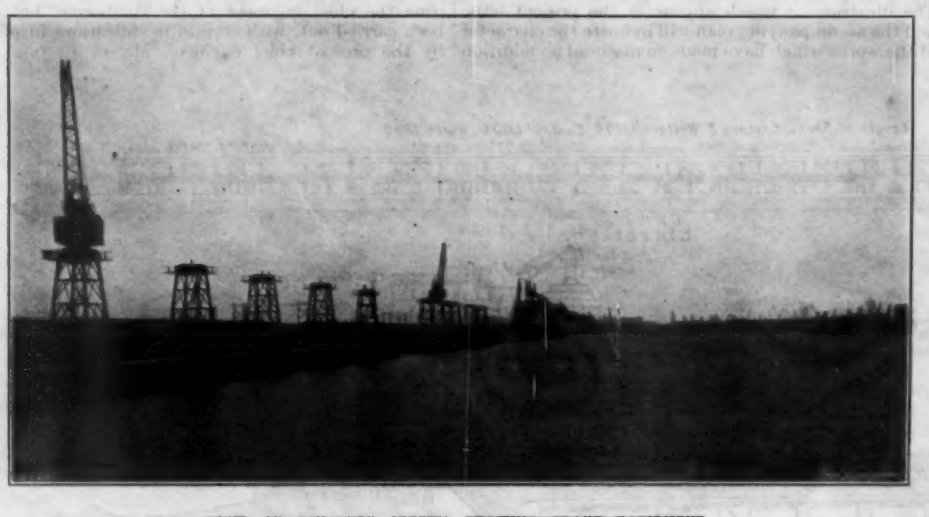
DOUBLE BASCULE BRIDGE CARRYING DIVERTED WOOLWICH MANOR WAY OVER LOCK ENTRANCE

FEATURES OF THE ALBERT DOCK SCHEME.

The new Albert Dock works have been in hand for a period of ten years, and their execution has absorbed a considerable percentage of the £10,000,000 which have been expended by the Port of London Authority since it came into existence in the year 1909. Although the dock has only now been formally opened, it has been in partial use for some time past, and during the war period some of the warehouse accommodation was pressed into service at a time when congestion at the Port of London had reached a somewhat acute stage. The engineering scheme for the works was prepared by Mr. Frederick Palmer, who was at that time the chief engineer of the Authority, but has been carried out, with certain modifications in plans, by the present chief engineer, Mr. C. R. S. Kirkpatrick, and during the whole period of execution Mr. Asa Binns has acted as resident engineer.

The scheme provided for a wet dock of some 64 acres, with a depth of water over the greater part of that area of 38ft. The length of the dock is 4500ft., and the breadth varies from 500ft. to 700ft. When it is fully equipped—there is a considerable amount of work still to be carried out—the dock will provide berthage simultaneously for fourteen of the largest ships trading to the Port of London. The access to the dock from the river Thames is obtained by an entrance lock, 800ft. long by 100ft. wide, in which a depth of 45ft. at Trinity High Water Level has been provided. The lock as at present arranged can be divided into two compartments of 250ft. and 550ft. respectively, three pairs of hydraulically operated steel gates, for which a contract was placed with

Sir William Arrol and Co., Limited, having been fitted. It was felt, however, by those responsible for the design that even a length of 800ft. might not be sufficient to meet the requirements of very large



VIEW OF CONCRETE JETTIES SHOWING CRANE EQUIPMENT

ships, and there was doubtless in mind the fact that the entrance lock to Newport Docks is 1000ft. in length. Provision was therefore made in the final plans for extending the entrance lock by means of a floating caisson to the length of 910ft. The lock has been prolonged by two curved jetties which give it a bell-shaped mouth. An additional access to the dock has been cut from the existing Royal Albert Dock, this passage, like the main entrance from the river, being 100ft. in width. An interesting feature of the design is the provision of seven reinforced concrete jetties, each 520ft. long. A very large extent of quayage is, of course, available, and ample warehouse accommodation, while at the western end of the wet dock a large graving dock, 750ft. long, 100ft. wide, and with a depth of 35ft. over the keel blocks, has been constructed.

These are the main features of the scheme, and reference may now be made to some of the engineering aspects of the project. The site of the dock was marsh land, mainly below the level of the river, and there was therefore a natural embankment which required but little additional work to strengthen it to enable the dock construction to be carried out in the dry, while the low level of the land has reduced the amount of excavation required. The amount of material which has had to be removed is, in round figures, 3½ million cubic yards, and, in addition to the usual grabs and steam navvies for the work of excavation, the contractors' plant—the early stages of the work having been carried out by Messrs. S. Pearson and Sons—included Lubecker land dredgers, each capable of dealing with 2000 cubic yards of material per working day. The spoil was handled by special hoists, designed on the principle of hydraulic coal tips, each of these hoists being capable of dealing with 500 cubic yards per hour. The excavated material was delivered by this means into hopper barges and taken down the river and dumped at sea.

The depth of the dock walls, the design of which is indicated in the illustrations, averages about 70ft. from 20.5ft. at the base down to 8ft. at summit level.

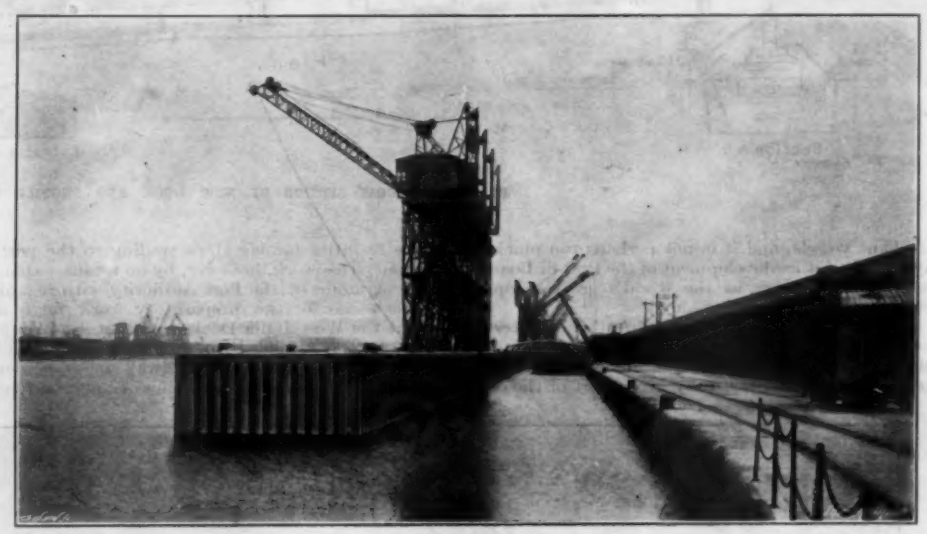
INTERIOR VIEW OF ONE OF THE 1100-FEET BY 120-FEET SHEDS

Mass concrete of 8 to 1 has been used for the general construction of the walls with a 3 to 1 concrete for the facing material, except for the small section of

Reinforced Concrete Jetties.

The jetties, which form so conspicuous a feature of the dock design, and which are admirably shown in one of the illustrations, have been constructed in reinforced concrete on the Considère system. All the jetties follow the same dimensions and design. They lie parallel with the quay wall on the south side of the dock, with a space between the quay and jetty, 32ft. wide, the intention being that this space will serve as a lay-by for barges. An excellent crane equipment is provided for the jetties. It consists mainly of 3-ton electrically operated cranes, and when vessels are berthed at the jetties it will be possible for cargoes to be transferred from the ship, either into barges lying alongside or directly on to the quay itself. For the handling of heavy loads two floating derricks, one of 100 tons and the other of 10 tons capacity, are included in the equipment. These floating derricks, which will be of the self-propelled type, are designed for hoisting, luffing and slewing operations. A fine shed equipment is provided on the south side of the dock behind the row of jetties. Seven single-storey sheds in steel and corrugated iron, ranging in length from 480ft. to 520ft., and in each case 120ft. wide, and all having good road and rail access, have been completed. The warehouse accommodation on the northern side of the dock is only partially completed, but only one of the three two-storey warehouses, which are to be built in reinforced concrete, is finished. One of our illustrations indicate the fine dimensions of these sheds, each 1100ft. long and 120ft. wide. Work on the other two sheds, which are being built up on piled foundations, is now in progress, and the installation of the necessary handling equipment is in a forward state.

In connection with the graving dock, a crane of 25 tons capacity for dealing with heavy loads is now in place, and a complete plant for effecting ship repairs, including air compressors for riveting work, has been installed. The pumping machinery for the graving dock consists of two main centrifugal pumps of the Drysdale type, having 48in. delivery pipes, the pumps being operated by two electric motors of 880 horse-power each. Pumps for drainage have also been installed. For the purpose of maintaining the water in the new dock at the same level as in the adjacent Albert Dock, *i.e.*, 2½ft. above Trinity High Water,



VIEW ALONG SOUTH QUAY AND ONE OF THE CONCRETE JETTIES

three 70in. Allen centrifugal pumps, dasigned to deliver 45,000 cub. ft. of water per minute, are provided.

Reference has been made to the fact that the road known as Woolwich Manor Way crossed the dock site, and provision has had to be made for the diversion of this road and its reconstruction over a considerable length. One of the views on p. 40 shows the new road where it crosses the lock entrance. At this point it takes the form of a double bascule bridge, which is a notable example of the work of Sir William Arrol and Co. The same firm has supplied a swing bridge carrying the road and railway over the entrance passage from the Royal Albert Dock. Sewage, water and gas mains have also had to be diverted, mainly at the point where they were intercepted by the excavation for the entrance lock. The most important of these is the double line of County Council main sewer, which is carried under the entrance lock in tunnels measuring 6½ft. by 5½ft., built up of cast iron rings. Another important piece of work was the diversion of four culverts, carrying water, gas, electric and hydraulic mains.

Another subsidiary work was the construction of some miles of railway and road, both for internal transport at the dock and to give communication to the local railway and road systems. It has also been necessary to undertake a housing scheme in the vicinity of the new dock to provide homes for a considerable population whose dwellings were demolished. In all, over 200 houses have been built adjacent to the Beckton-road recreation ground.

A point which should be noted is that the present dock scheme has been designed and carried out with the possibility in mind of constructing at a future date a still larger dock on adjoining land, but of this scheme nothing has been heard for a long time past, and it is not likely to be carried out until some of the other work in hand has been completed.

The Engineering Conferences.

No. II.*

THE INSTITUTION OF CIVIL ENGINEERS.

IN our last issue we described the opening of the Engineering Conference convened by the Institution of Civil Engineers, which took place on Wednesday, Thursday and Friday of last week. Below we give the conclusion of the first day's proceedings.

SECTION I.—RAILWAYS, ROADS, BRIDGES AND TUNNELS.

Two papers were read and discussed before this section on June 29th. In the first, Mr. Alexander Ross dealt with "The Structural Outlines of our Home Railways." He suggested that on main trunk lines the 6ft. space should be widened to 7ft. at the least. In the case of more than two lines of rails, the space between the original pair of rails and additional lines should not be less than 11ft. 6in. No overhead structure should have less clear headway than 15ft. 6in. above the top surface of the rails. No structure higher than 2ft. 6in. above rail level should be nearer to the edge of the nearest rail than 5ft. Incidentally, this provision involves the question of raised platforms, which, if continental rolling stock is to be run on our lines, must receive consideration. In the case of four lines of way, what, he asked, are the relative advantages and disadvantages of the lines being disposed in pairs up and down with the dividing wider space between, or the two main lines occupying the centre with an additional line on either side?

The discussion was opened by Sir Douglas Fox, who would increase the width between the running lines from 6ft. to 7ft., to add to the safety of the men. Sir Vincent Raven was satisfied with 6ft. if he could get it everywhere; 18in. between passing coaches was sufficient for oscillation and inequalities in the rails. Neither did he think an increase in the 10ft. space was necessary. Electric traction was the means of transport of the future, and electric locomotives called for as high a structure as possible. Bridges should be designed to carry an axle load of 25 tons. The possible exchange of rolling stock with the Continent had been considered, but it would be out of the question as far as cost is concerned. Continental rolling stock could not be brought further than some gathering ground near London. Mr. W. W. Grierson was not altogether in agreement with all Mr. Ross had advocated; it would be an enormous expense to increase the 6ft. space to 7ft., and except where there were signals the 10ft. width outside was sufficient.

In the second paper Mr. O. S. C. Drury discussed "Tunnel Maintenance." On the London, Brighton and South Coast Railway there are, he said, forty-one tunnels, of a total length of 13.2 miles, running through chalk, clay, and sand or sand-rock. Abnormal works of maintenance had been carried out in eleven of these tunnels, aggregating 4¼ miles in length, or one-third of the total length of tunnels on the system. Of the 4¼ miles specially dealt with, 2.88 miles were in chalk tunnels, being about 40 per cent. of their total length; 1¾ miles in clay tunnels, being about 38 per cent. of their total length; and four-fifths of a mile in sand or sand-rock tunnels, being about 49 per cent. of their total length. The abnormal maintenance had therefore been practically equal in all three kinds of material. Particular reference was made to Oxted tunnel, which is in chalk. The late Sir James Ball determined to strengthen the middle band of 1130 yards of four-ring work, and selected the Ingersol cement gun as a suitable means. A contract was let for the cutting of access holes for inspection and packing of spaces and for grouting under pressure and for pressure grouting through holes to be drilled in the brickwork. But on opening up the tunnel, parts of the brickwork were found to be defective, owing to soft and underburnt bricks and shortage of mortar. In parts also the arch was distorted, and virtually no packing had been done. Spaces were found outside the walls averaging about 7in. throughout and above the arch ranging from 3in. to 14ft. high.

In view of its state, Sir James decided to cut out and rebuild 5ft. bands at intervals, and a certain amount was done in that way, but the method has since been abandoned. Where the arch is found distorted it is being rebuilt, and in the remainder of the middle length grout only is being used. In addition to the grouting it is proposed to cover the face ring of the tunnel with the same mixture, blown on. Sufficient face work has already been done to prove its success. Generally, the experience of tunnel maintenance on the Brighton line had shown that the troubles experienced were mainly due to the use of unsuitable material, and to the lack of proper supervision and care in carrying out the work during construction.

Mr. G. Ellson said that on the South-Eastern and Chatham the bulk of the maintenance was due to the bricks being unable to withstand the pressure and atmospheric influences. From 1902 to 1912 the cost of repairs on 8 miles of tunnel was 15s. per lineal yard of tunnel; elsewhere the cost was 9d. per yard. The cement gun should be used with care. Mr. E. C. Trench observed that seldom were there faults in the design of tunnels. The causes might be put under four heads:—(1) Defects in workmanship; (2) failure to build in the cavities completely and the use of unsuitable material; (3) water in the tunnels; (4) bad ventilation. Mr. H. H. Dalrymple-Hay considered that for successful maintenance it was necessary to know the nature of the ground and how the work was done. But who knows what was done eighty years ago? The Chairman remarked that the bulk of his own work of this character had been necessitated by bad workmanship behind the brickwork. A three-mile tunnel that never gave trouble was designed by the late Mr. Watson Breck.

SECTIONS II. AND V.

DOCKS AND HARBOURS.

A joint meeting of Sections 2 and 5 was held for the purpose of discussing a group of papers dealing with dock engineering. Sir Maurice Fitzmaurice occupied the chair.

In the first of the papers presented, Mr. C. R. S. Kirkpatrick raised the question as to the dimensions to which future docks should be constructed. His opinion is that the present check in giant ship construction is only temporary, and is due to the absence of the necessary port facilities, the high cost of construction and repair, dear money, and the difficulty of insuring such high values of craft and cargo in one bottom. Future dock construction should, he thinks, provide entrance locks not less than 1150ft. long by 130ft. wide, with a depth of 45ft.

Developments in ship and harbour design and equipment was the subject of a short contribution by Mr. A. R. T. Woods. His criticism of British dock systems was that they have been planned without foresight or any anticipation of the trend of ship design. The great need was, he insisted, for more mechanical equipment. The problem of providing improved facilities for the Port of London might, he thought, be solved by the dockising of the Thames.

The subject of cranage facilities for discharging vessels of the largest size was introduced by Mr. Henry J. Deane. His main argument was directed to a consideration of the question whether discharging facilities should be provided on the quay or on the ship.

The discussion ranged over all these points. The suggestion that the Thames should be converted into a huge wet dock by the construction of a barrage drew a vigorous protest from Mr. Kirkpatrick, the engineer to the Port Authority, whose views as to the impracticability of such a project were supported by a well-known dock engineer in the person of Mr. Charles Meik. One objection to the construction of a Thames barrage with this object was that the entrance facilities to the port would be so small in comparison with the berthage available as to make the dockising of the Thames undesirable from that point of view alone. Mr. Freeman, the American engineer, regarded the project as feasible. With regard to the future dimensions to which docks should be constructed, Sir Westcott Abell took the view that outside the few leviathans in service, dock authorities would not be called upon during the next few years to make provision for larger vessels than passenger ships of 800ft in length, combined passenger and cargo ships of 600ft., and cargo ships of 400ft. As regards dock accommodation for the few mammoth liners in service, it could be met by the construction of a single floating dock. Sir Maurice Fitzmaurice was able to give some information on the subject of dock equipment as the result of a recent visit to a large number of ports. There are, he reminded the Conference, no wharf cranes in the ports of Montreal, Vancouver, Yokohama, Kobe, Manilla, Singapore, or Colombo. On the subject of dock dimensions in relation to size of ship, he had asked the Colonial Office to convene a conference of all the shipping companies running services on the Suez Canal route so that definite information might be available as to what provision should be made for any increase in the size of ships during the next ten years. Mr. F. G. Wilson did not believe there would be any material advance in the size of ships during that period, a statement which will doubtless be welcomed by dock authorities, who, as Mr. F. E. Wentworth Sheilds pointed out, in such an event might be involved in operations in the enlarging and deepening of docks and approach channels of a very costly character.

REINFORCED CONCRETE FOR MARINE STRUCTURES.

Three short papers on reinforced concrete were presented at the afternoon meeting of Section II.

It was in the early years of the present century that the increasing scarcity and cost of suitable timber for wharf and jetty construction caused the adoption of reinforced concrete for such work. Mr. Gerald FitzGibbon, in a brief review of the subject, suggested the possible advantages of the caisson method of construction for deep water wharves and breakwaters both as regards economy in cost and time in construction. This method had, he said, been successfully adopted for works in Denmark, of which the recently completed Kronelöbs Basin at Copenhagen was a notable example. Messrs. S. Pearson and Son were employing the same system at Valparaiso, where the submerged portion of a breakwater was being formed of reinforced concrete caissons weighing 2430 tons each, which were being sunk in 46ft. of water. The same method was also being employed on the Amsterdam Ship Canal in connection with the new lock at Ymuiden. This lock was 1110ft. long, 165ft. wide, with 49½ft. over the sill. Both the lock heads, lock walls, and gate recesses were being constructed as reinforced concrete caissons.

Some of the reasons for the deterioration of reinforced concrete structures above mean tide level were referred to Mr. L. H. Savile. He commented on the fact that in many structures serious defects had been noticed in reinforced concrete work above mean tide level. Cracks developed, leaving the main reinforcement bar bare, and this not only happened to the upper portion of the piles and the diagonal and horizontal bracing, but to deck beams which were well above high-water level. Several theories were put forward by Mr. Savile on the subject to account for the deterioration. His main object, however, in his short contribution to the discussion was to ask engineers to give their experience of defects of this nature, and to ascertain how they are to be accounted for in view of the fact that they did not appear to occur below mean tide level.

Definite suggestions for the protection of reinforced concrete were made by Mr. F. E. Wentworth Sheilds as his contribution to the debate. Broadly speaking, it had been noted, he said, that the steel in reinforced concrete was well protected from rust provided the concrete was of good quality. Experience had shown, however, that in some maritime structures moisture and air had penetrated through good concrete to the steel, causing the latter to rust and swell and to crack or burst off the concrete covering. Perhaps the most effective way of preventing all kinds of deterioration was to make the concrete highly impermeable. Many means had been suggested to this end, but their relative importance was uncertain and the matter required further investigation. Probably the best pore filler was Portland cement itself in rich mixtures. Another means of preservation was the coating of the outside of the concrete with some kind of impervious liquid, of which paraffin wax, bituminous paint, tar, and various kinds of linseed oil paint were more or less effective. Such paints must not be applied until the concrete had matured for some months. A simple test for permeability was badly needed.

It was mentioned by Sir Maurice Fitzmaurice that most of the reinforced concrete marine structures on the American coast were now showing evidences of deterioration or failure due to the corrosion of the reinforcement.

SECTION III.—MACHINERY.

The chair was taken by Captain Riall Sankey at 11.35 a.m., when the first note, entitled "Comparison between Reciprocating Pumping Engines and Turbo-driven Centrifugal Pumps," was read in abstract by the author, Mr. Hugh Lupton. As centrifugal pumps are unsuitable for wells, the subject is limited to the consideration of cases in which the water is within suction distance of the pump, and in which the horse-power is from 150 to 600, measured in water lifted. The principal points are reliability, running costs and capital cost. Reliability: The author points out that the piston speed of a reciprocating engine working plunger pumps is from 180ft. to 280ft. per minute, while for a steam turbine the number of revolutions may be anything from 3000 to 10,000 revolutions per minute. The turbine pump runs, of course, at a high speed, but reduction gear is necessary between the steam turbine and the pump. He cites a triple vertical reciprocating engine installed at Bristol in 1914, which when new used 12.37 lb. steam per pump horse-power, and when tested in January, 1921, used 12.6 lb., showing very slight deterioration. The total cost of repairs since the engine started was £50 12s. 6d. On the other hand, turbine plants are very liable to breakdown. Running costs: Of these, the most important is fuel, and here again the reciprocating pump has the advantage. The steam consumption varies from 13 lb. to 11 lb. per actual pump horse-power hour in water lifted. The figures are calculated on an efficiency of 65 per cent. for the steam raising portion, 20 per cent. added for general losses, and a further 10 per cent. for deterioration. Coal of a calorific value of 13,000 B.Th.U. per lb. is taken at 40s. per ton. With the turbine-driven pump, the actual coal consumption would be 14.5 lb. to 20.5 lb. per actual pump horse-power. The coal cost for 300 days of twelve hours would be from £9 6s. to £12 6s., as against £6 16s. to £7 10s. for the reciprocating engine. Capital cost: The turbine plant is less costly than the reciprocating pump. The general conclusion is that where an all-the-year-round load is anticipated, the triple reciprocating engine with direct coupled ram pumps is the most advantageous proposition, but for stand-by plant the turbine-driven pump has the advantage.

In the discussion, several of the speakers alluded to the fact that whereas the reciprocating pumps had many years of experience behind them, turbine pumps were a quite modern invention. One speaker, Mr. Maude, went so far as to say that the present type of turbine pump will be obsolete in fifteen years or so. Mr. Richard Allen mentioned the saving of space that was effected on board ship by the use of turbine pumps, and the author replied that there was little need to save space in pumping houses ashore, but, on the same point, Mr. J. H. Barker, of Greenwood

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and Batleys, stated that whilst the foundations and buildings for a set of reciprocating pumps might cost £15,000, those required for turbine pumps of the same power could be built for £5000.

The chair was then taken by Professor W. E. Dalby, and Mr. E. R. Dolby read in abstract his note, entitled "Exhaust Steam: Its Employment for Power, Heating, &c." The chief points were as follows:—In non-condensing engines about 90 per cent. of the heat which is contained in the steam is discharged with the exhaust, and in the condensing engine or turbine about 60 per cent. of the total heat in the fuel burned passes to waste with the cooling water effluent from the condenser. If, in a given case, there is a constant demand for power, and at the same time a demand for heat which may be exactly supplied by the utilisation of the heat ejected by the prime mover, then the solution of the problem is simple. In practice, this ideal condition is rarely met. In the opinion of the author, the most efficient utilisation of the thermal value in coal cannot be obtained until there are sets of public mains provided by the community for public utility. One set of the mains might receive electric energy in the form of alternating current at a standard pressure and frequency; another set might receive steam at a pressure of 5 lb. to 10 lb. per square inch; while a third set would deliver water at a temperature of 180 deg. to 200 deg. Fah. The subsidiary electric mains would be coupled to the existing public supply mains, as is now the case on the North-East Coast of England, the consumer being paid for what he delivers and charged for what he consumes. The steam mains would furnish direct heating in radiators, drying chambers and calorifiers for the supply of domestic hot water, and wherever practicable the condensate would be drawn back by an air pump to the starting point. Such mains are common in the United States, although rare in Great Britain, but several large blocks of buildings in Manchester are supplied with exhaust steam from an electric generating station. The hot-water mains would convey water heated in exhaust steam calorifiers and circulated by pumps.

There was a good discussion on this paper, and it turned principally on Mr. Dolby's proposals for the supply of steam and hot water, but several speakers gave examples of the advantage of utilising the exhaust for industrial purposes, Mr. R. W. Weekes instancing a case in his own practice of an engine exhausting at 60 lb. per square inch, which reduced the consumption of coal to 8000 tons per annum, as against 12,800 tons used by a condensing engine which it replaced. Mr. F. Biggin mentioned the case of a public institution in London which had reduced its coal consumption from 4000 tons per annum to 3200 tons by using exhaust steam.

On the other question, several speakers favoured the supply of hot water, but not of steam, and references having been made to American practice, Mr. Edgar Herring pointed out the difficulties that would have to be faced in big British cities, where the ground was already full of pipes and cables.

SECTION IV.—MINING AND METALLURGICAL PROCESSES.

Sir Robert Hadfield, F.R.S., read a long address as chairman of this section, in which he first gave figures of America's progress regarding oil and coal output, from which it was seen that the output of steel ingots and castings had grown from 14 million tons in 1880 to 45 million tons in 1917. Figures were also given of the increase in German output since the Armistice. Thus pig iron increased from 6,290,000 tons in 1919 to 7,500,000 tons in 1920; steel ingots from 7,770,000 tons to 8,000,000 tons; and iron and steel exports from 125,000 tons to 1,600,000 tons. The figures for 1921 would also show, basing them on returns for the first five months, how hard Germany was working. The world was literally craving at the present time for millions of tons of iron and steel, and to economise in its use, as some people suggested, meant a reduction of the development of civilisation, because without this metal the world would lapse almost into a state of barbarism. Sir Robert then dealt with the subject of deoxidisers, and referred to the researches in America upon the action of deoxidisation and with a view to finding mixtures or alloys possessing low melting points suitable to act as scavenging oxides. This work has been described in a paper by Dr. J. R. Cain, of the Bureau of Standards, Washington, and it was shown that no fewer than seventy-three deoxidising alloys, many of them of possible value to the metallurgist, and chiefly to the steel makers, had melting points, when oxidised, below the melting point of pure iron. This subject deserved study on this side of the water. Speaking next on corrosion, Sir Robert said he doubted whether the very serious wastage of iron and steel which went on from year to year was realised. From this source alone there must be an annual wastage on the rough estimated total of 1860 million tons of iron and steel produced between 1880 and 1920, and the amount required to make up this loss was therefore very considerable. He proposed shortly to submit a paper dealing with this subject to the Institution of Civil Engineers.

Fuel economy was the next subject dealt with, and it was stated that the ultimate basis upon which our considerations of fuel value must rest was the accurately ascertained calorific value of the fuel. At the present time in Sheffield, for one penny, about 50,000 to 60,000 B.Th.Us. were obtainable in the form of bituminous coal and about 30,000 to 40,000 in the form of metallurgical coke. Liquid and gaseous fuels were more expensive, so that considerable improvement in efficiency and reduction in labour costs must be made if they were to be applied. The recent fall in the price of fuel oil pointed to the possibility of the utilisation of this, provided the relatively lower prices were maintained. As to water power, reference was made to the enormous possibilities of the Niagara Falls yet to be developed, only 695,000 horse-power at present being utilised out of nearly 6,500,000 horse-power. In this country developments were in hand in connection with the Lochaber Falls and the Grampian scheme, the first of which could be developed up to 100,000 horse-power, and the latter also on a comparatively large scale, although puny beside Niagara.

A paper on "The Employment of Water Power in the Development of the Mineral Industry" was then read by Mr. J. W. Evans, F.R.S. The author pointed out that the use of water power in mining and ore dressing was almost, if not quite, as old as mining itself, and electric energy produced by water power had also been widely utilised in electrolysis for the production of almost chemically pure copper, zinc, and nickel, and above all in the production of metallic aluminium. The electrical reduction of iron was also making way. During the war there was a remarkable advance in Sweden, where the number of electric furnaces employed in this industry increased from 8 in 1914 to 25 in 1917 and 28 in 1918, and the output of pig iron obtained from them increased from 5786 tons in 1911 to 75,684 in 1918. The day was at hand when electrolytic methods would enable metals to be extracted with commercial success from ores which were too poor to be dealt with by melting operations. The problem of utilising the water power of the mountain areas of the United Kingdom was complicated by the objections which were very properly urged against interference with the scenic beauty of the areas where the water power was available, which was an obstacle which it was the duty of engineers to overcome. The question was urgent, because we could only secure the output of aluminium in this country, which national considerations demanded, if there was a considerably greater utilisation of water power than had hitherto been permitted.

In the discussion Mr. W. M. Morrison (British Aluminium Company), although interested in aluminium, said there was a great future for the electrolytic production of cheap iron and also magnesium, if it could be produced at a reasonably low cost. So far as the amenities of the districts in this country containing water power were concerned, it was difficult for the engineer to look upon the matter in any other than the utilitarian manner. When the power at Lochaber was fully developed the output would be something of the order of 600,000,000 units per annum. Mr. Theodore Stevens said that the figures from the Swedish Board of Trade returns did not agree with those Dr. Evans had given. According to Dr. Evans, 75,000 tons were produced in twenty-eight electrical furnaces in 1918, but the figures he had were an average of 6400 per furnace running seven furnaces, 8400 tons per furnace in 1919 with eight furnaces, whilst in 1920 eleven furnaces were working, giving 7000 tons per furnace.

Mr. Nicholson (Punjab Irrigation) spoke of a proposal to export bauxite from the Central Provinces of India to America. In the Himalayas there were vast and little explored minerals; some of the finest and purest deposits of magnetite ore were within 40 miles of the power stations he had been connected with in India, whilst the Jhelum power station was in the midst of a very fine limestone formation.

The next paper was on "Recent Developments in Coal Cleaning Processes," by Mr. Robert Nelson. In this paper the serious position due to the increase of the ash content of industrial coals is pointed out, the average being at least 5 per cent. more than the pre-war average. The paper describes two processes of recent development, one of which has the added interest that it is new in principle. The chief difficulty in coal washing by the older methods is to deal effectively and efficiently with fine coal. The process referred to as new in principle offers a solution of this difficulty. The other process, on the other hand, attains an unusually high degree of efficiency in dealing with coals of all sizes from 2½in. downwards. A proper combination of the two would seem to offer an adequate solution over the whole range of coal cleaning. The new process of washing fine coal is independent of gravity and is a flotation process. The new process for cleaning coal other than "fines" comes to this country from Belgium and is called the Rheolaveur process, one such plant now being in course of erection by the Butterley Company. In this the coal is carried by special means through a stream of water confined in a series of narrow channels, the separation of the coal and dirt being effected by stratification. The importance of cleaning coal cannot be over-emphasised when the cost of transport and labour in handling such large percentages of ash as are now common is taken into consideration.

In the discussion Colonel Rhodes said that it was possible without great complications to wash coal above a certain size, but if, as he understood was the case, it was necessary in the new process to crush the coal to below the tenth of an inch, then the difficulties became very great. Mr. C. H. Merz, speaking as a large user of coal, said that not only were there the difficulties mentioned of transporting large quantities of this coal and handling the ash, but very often the efficiency of the consumption of the coal was interfered with by the presence of the dirt in the coal. If the colliery owners wished to increase the demand for their products, then it was necessary for them to go into the question of supplying consumers, large and small, with the fuel they wanted, and not with just what came out of the pit. Mr. Nelson, in reply, said he was pleased that Mr. Merz, as a large user, was not prepared to lie down under the infliction of the dirty fuel which had been sent out from the pits during the control period.

The final paper in Section IV. on June 29th was on "The François Cementation Process," by Mr. H. S. Ball. This process of sinking was originally started in France sixty years ago, but was only introduced into England in 1911 by M. François, many developments having been made and patented by him. Prior to this, cementation was used mainly in connection with mining operations; its sphere of operation has, however, lately become enlarged to such an extent that it is being used to solve various types of engineering problems in many parts of the world. The process has recently been used for sinking through water-bearing strata in England, sealing off leakages in a reservoir in Scotland, repairing the damaged shafts of the Lens concessions in France, consolidating the foundations of a foundry in the Ardennes, constructing an underground dam on the Rand, and cementing the retaining wall foundations of the Mazoe Dam, Rhodesia. The principle of cementation is the injection of underground fissures with liquid cement under high pressure, such injection being continued until the fissures are completely filled and the water previously issuing therefrom sealed off. To effect this result, holes are bored by means of any of the well-known drilling machines, and upon a fissure being encountered, the boring rods are withdrawn and a pipe range leading to a high-pressure pump, capable of exerting 4000 lb. per square inch, is connected to the bore-hole. The chief application of cementation in mining is the sinking of shafts through watery strata, and for this purpose it has practically superseded the freezing process.

Mr. H. A. Marriot, in a written communication, gave some details of the circumstances in which he had used the process in various parts of the world. There was no doubt, he said, that the process would greatly simplify the lay-out of large water supply schemes by rendering the tunnels, driven for the transport of water, impervious alike to loss from within or percolation into the tunnel from without. In railway tunnels, too, which were subject to moving ground or expensive in upkeep owing to the amount of water that had to be pumped from them, a large saving in standing costs could be effected by the use of this process, and there was some cause for surprise that those who were responsible for the Severn Tunnel had not yet carried out tests to see whether those works could not be made permanently as dry as many a shaft that had been driven under more difficult conditions.

The papers discussed before Sections VI. and VII. were referred to in our last issue.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE Conference at the Institution of Mechanical Engineers opened on Thursday morning in the Library of the Institution building, when Captain Riall Sankey briefly alluded to the work before the members, and extended a welcome to the American delegation. In this welcome he laid stress upon the desirability of bringing the engineering societies of this country into closer union and held up as an example the American model. He then announced that at a recent meeting the Council had decided by acclamation to confer the distinction of Honorary Membership upon the veteran engineer and scientist, Mr. Ambrose Swasey, past-President of the American Society of Mechanical Engineers. In pursuance of this decision a certificate of Honorary Membership, in which the recipient's qualifications were set forth, had been drawn up and sealed with the great seal of the Institution, and he handed it to Mr. Swasey. Mr. Swasey, who received a very cordial welcome from the meeting, acknowledged in a feeling speech the honour that had been done him, and spoke of his constant admiration for, and devotion to, the Institution of which he had been a member for many years. Mr. Charles Rand, of the American delegation, then said a few words about the organisation of the American engineering societies, and put forward the excellent suggestion that if it were impossible, owing to existing circumstances, to bring the British engineering societies under one roof, at least an effort might be made to amalgamate their libraries.

These initial proceedings over, the members separated to attend the four concurrent meetings, which were held in the building, or to examine the exhibits.

THE CHEMISTRY OF COMBUSTION.

Mr. E. V. Evans, chemist to the South Metropolitan Gas Company, presented a paper on this subject in the Reading Room, under the chairmanship of Dr. Hele-Shaw.

The author appealed against the use of raw coal for the generation of heat for two specific reasons, namely, the highly complex nature of the reactions, both physical and chemical, which took place during the combustion, and the loss of raw material which resulted. It was now generally accepted that the primary product of the oxidation of carbon was a complex of carbon and oxygen, which had a transitory existence. This complex decomposed into a mixture of carbon monoxide and carbon dioxide in proportions which depended upon the temperatures at which decomposition took place. The combustion of the simpler gaseous hydrocarbons introduced reactions which were more complex. Although combination with oxygen at high temperatures appeared to take place in a simple manner, that was not really the case. When combustion proceeded at low temperatures in the presence of a catalyst, many intermediate products were formed before the final product, carbon dioxide and water vapour, emerged. The apparent simplicity of the reactions involved in the combustion of simple gaseous hydrocarbons was due to the high velocity of the reactions at high temperatures.

In the case of the combustion of raw coal, the complexity of the reactions which took place during oxidation was augmented by a number of side reactions of a physical as well as of a chemical nature. The process was preceded and accompanied by the decomposition of the coal substance. Long before the ignition temperature of the coal was reached some of the coal substance melted or decomposed into less complex bodies, and frequently with the evolution of gas, whilst the newly formed degradation products might also melt and further decompose. If the boiling point of any of these liquids were lower than the temperature of decomposition, distillation would immediately take place, and if the vapours came into contact with a cooler zone, condensation and smoke formation would result.

A factor to be considered in connection with the combustion of smoke was that it was usually evolved in a zone already highly charged with products of combustion from the fire below. For this reason a suitable excess of air must be provided, and if air were admitted to the combustion chamber above the level of the fire, it must be pre-heated to avoid cooling the products below the ignition temperature. The combustion of oil fuel and powdered coal could be controlled in the same way as that of gaseous fuel, though perhaps not to the same extent.

The discussion turned in part upon the employment of powdered fuel and more largely upon the use of oil burners in steam boiler practice. Several of the speakers alluded particularly to the high temperature of combustion when burning oil, which resulted in the destruction of furnace linings. Mr. Marshall, speaking for the Scarab Oil Burning Company, whilst agreeing that greater efficiency could be reached by pre-heating the air—as, for example, by passing it through passages built in the floor of the furnace—said he was forced to the opinion that with boiler work it was better to sacrifice the increase of efficiency for the sake of augmenting the life of the fire-bricks. The lack of understanding of oil-fuel combustion in boilers was also mentioned, and the problem of obtaining complete combustion was discussed in connection with the smoke problem. It was agreed by the author and others that the most economical results were achieved when a slight grey smoke was given off. If there was no smoke, there was too much air. Mr. H. M. Ridge gave an interesting account of his efforts to burn coal in three stages—first, driving off the volatiles; secondly, gasifying the coke; and finally, adding sufficient pre-heated air to oxidise the CO and the hydrogen. The result of separating the operation into these three phases was that a week's average for the flue gases showed 17 per cent. of CO_2.

BLAST-FURNACE GASES.

A paper was then read on "Blast-furnace Gases," by Messrs. A. Hutchinson and F. Bainbridge. The authors treated their subject largely from the historical point of view, a good portion of their paper being devoted to recording the steps taken to utilise waste heat from blast-furnaces and coke ovens from 1828, when Neilson advocated the use of the hot blast, onwards to the present date. The advent of the large gas engine and of improved means of cleaning the gas were held to have revolutionised the whole question. The authors stated that a satisfactory cleaning process not only enabled the gas to be used with advantage in a gas engine and permitted the potash in the dust to be recovered, but also economised the consumption of gas in the stoves and under the boilers, reduced the number of stoves and boilers required, and improved their control and increased the volume and quality of the spare gas available. In the Cleveland district, the authors said, an average of 23.5 cwt. of coke were required per ton of pig iron produced. The furnace gas amounted to 184,000 cubic feet per ton of pig, and was used to the extent of 50 per cent. under boilers and 30 per cent. in stoves, with 20 per cent. remaining as surplus. In the dry state the gas from furnaces smelting Cleveland ironstone contained, roughly, 10 per cent. carbon dioxide, 30 per cent. carbon monoxide, 1 per cent. hydrogen, and 59 per cent. nitrogen, the net calorific value being 100 B.Th.U's. per cubic foot. The concentration of by-product coke ovens, blast-furnaces, steel works, and rolling mills in one plant was recommended as a means of economising fuel, and support was given to Dr. Bone's estimate that with the plant so grouped it should be possible to produce 1 ton of finished sectional steel for not more than 1.6 tons of coal.

The discussion centred chiefly upon the co-operative use of surplus blast-furnace and coke-oven gas. One speaker suggested that all such gas shoud be turned into a common main and transmitted to an electricity generating station. Were such an outlet for the gas made available blast-furnace and coke oven owners would be encouraged to save as much gas as possible, and not, as very generally at present, only sufficient for their own needs. It was recognised to be a difficulty in this matter that at the week-ends the works would continue to supply gas when the generating stations were not requiring it. The question of storing the gas was raised in this connection, but Mr. Hutchinson replied that while gasometers for the purpose were to be found at the Cockerill works, their immense size would not in general permit their economical installation on a co-operative basis. He suggested, however, that the "week-end" gas might possibly be profitably utilised for the manufacture of synthetic nitrogen products.

BOILER-HOUSE MANAGEMENT AND LOW-TEMPERATURE CARBONISATION.

In the Council Room, with Mr. William H. Patchell, Vice-President, in the chair, a paper on "Boiler-house Management" was read by Mr. David Wilson, who, during the war, was one of the higher officials under the Coal Controller and lectured upon the subject of coal economy. He found, he said, little response to his efforts, and although 85 per cent. efficiency could be obtained in steam boilers under carefully arranged test conditions, and 75 per cent. to 80 per cent. are in certain cases obtained in actual practice, the average efficiency throughout the country would only be about 50 per cent., as stated by Mr. Brownlie. The highest efficiency was no doubt obtained in the large electric power stations, but there were in the country a great number of obsolete plants. The chief cause of the low efficiency was the lack of scientific supervision, and the small salaries usually offered were not tempting to clever men. One firm had appointed a combustion expert at £400 a year salary and found the financial saving he effected was so great that it had raised his salary to £1000 per annum. A saving of even 1 per cent. on the coal bill on large installations would suffice to permit the payment of a really good salary. Records of CO_2 and the temperature of gases should be regularly taken. Owners did not yet realise their responsibility, and though he was not, generally speaking, in favour of Government control, he thought something of that nature would be needed if the efficiency was to be improved.

In the discussion Mr. S. E. Fedden (Sheffield) said the author had struck the right note. Steam turbines and alternators were very efficient, but the boiler-house was a coal waster. At the electric generating station in Sheffield, before the war, 20 million units were generated annually, while last year 172 million units were sold and 5000 tons of coal were now burnt per week. He had appointed three shift engineers to control the boiler-house, but they could not look after the combustion. The thermal efficiency was then 65 per cent. on very poor coal. He therefore appointed a chemist, who now had become the combustion expert and had two or three assistants. The thermal efficiency had risen to 72 per cent. and even 75 per cent.; the saving of 10 per cent. made it possible to pay a high salary. During the war he employed 160 women and one man to every ten women to deal with the heaviest work. Lectures for the women were given after working hours; the women were paid to attend, and soon became very efficient stokers. Now that men stokers only were employed attendance at such lectures could not be obtained; better work was obtained from the women. Team work would be tried, and emulation might be created by a comparison of the results shown upon the gauges. Coal could not be bought now on the basis of calorific value. Coal sampling was difficult, but at the Sheffield station a sample was taken from every wagon and every hopper every day and subjected to both chemical and combustion tests. An agreement to buy coal on the basis of its thermal value was most desirable.

Mr. Brownlie (Manchester) agreed that the highest efficiency could only be obtained under proper scientific control. The average of 400 boiler plants in forty-one different industries showed an efficiency of only 58 per cent. He had inspected 2000 boiler plants, the general thermal efficiency of which was only 60 per cent. About 50 per cent. of the total coal used was burnt in steam boilers and about 15 to 20 million tons of coal were wasted per annum. Not 10 per cent. of the plants used water meters, not 1 per cent. used steam meters, and not 7½ per cent. used CO_2 recorders. In 25 per cent. of the boiler installations there were no economisers. Very few boiler doctors, as he might term them, received £1000 a year as salary. A new Swedish CO_2 apparatus was a distinct improvement on anything he had seen before. It was a mistake to stipulate for any special calorific value in purchasing coal, but there should be a sliding scale and the price should depend upon the calorific value.

Other speakers agreed as to the desirability of purchasing coal by calorific value and as to the advantages derived from the employment of an expert—at £400 to £500 per year—and from the encouragement of the team spirit amongst the stokers. Mr. Gill, of the South Metropolitan Gas Company, mentioned that in the company's retort-house the team which did the best work was allowed to fly a flag until it was beaten by some other team.

The Chairman then explained that Dr. W. A. Bone, the author of the paper on "Low Temperature Carbonisation," was prevented by illness from attending. Mr. Sinkinson read his paper. Low temperature carbonisation had a special bearing on domestic heating, and if such fuel could be produced at a price comparable with coal it would be very valuable. Before the war gas in Sheffield had a thermal value of 580 B.Th.U. and cost 15d. per 1000 cubic feet, or 2½d. per therm, while in London the figures were 550 B.Th.U., 30d., and 5½d. respectively. Now the relative figures were 10d. and 20d. per therm. With good house coal at 63s. per ton the coal therm would cost 2½d. and the gas therm six times as much. Gas cooking was still economical, but open fires were the most healthy; therefore a solid fuel was desirable. With raw coal at 63s. per ton low temperature carbonisation would produce a coke therm for 2½d. The coal was carbonised at 500 deg. to 600 deg. Cent., and about 4000 to 5000 cubic feet of rich gas could be obtained, as well as motor spirit. He referred to the following tabular statement:—

	Electric radiator.	Gas fire.	Open fire burning Raw coal.	Open fire burning Semi-coke.
Assumed radiant gross efficiency on gross calorific value of fuel, per cent.	100	44	24	32
Assumed prime cost of fuel, "per therm" of 100,000 B.Th.U., pence	60.0	15.0	2.5	3.0
Fuel cost per therm of radiation into room, pence	60.0	34.0	10.4	9.4

The discussion was then opened by Dr. Cecil Lander (H.M. Fuel Research Station), who said the report upon low temperature carbonisation was in preparation. A great deal of time had been spent on experiments at Greenwich. Various qualities of coal were used and 2 cwt. carbonised at a time. There were nine horizontal steel retorts; water gas was used for heating and the weight balances were obtained to within 1 per cent.; 120 coals and mixtures of coal had been tested. Laboratory assay tests corroborated the retort tests. He exhibited coke made in 3in. cubes. The labour costs were high—about 15s. per ton. Everything depends upon the possibility of obtaining suitable apparatus, and no decision could be reached as to the future prospects of the coke until it had been produced commercially upon a large scale. Mr. Wilkin (U.S.A.) said that they were carrying out similar work in the United States. In comparing the cost of raw coal and that of the coke, it must be borne in mind that the latter was smokeless and the expense of re-decoration of the houses must be set against the coal. Most of the speakers appeared to be very dubious about the financial success of the low temperature carbonisation process, but Mr. Sarjent (Sir R. Hadfield and Co.) said he had inspected the Barnsley works for low temperature carbonisation and believed there was a good future for the process. He described certain features of the process.

Mr. C. M. D. Belton (Shrewsbury) thought the figures in the author's table were open to challenge. The 30 per cent. CO bogey was only a bogey. It had been stated at the discussions at the Institution of Civil Engineers that the presence of CO was advantageous.

ENGINE-HOUSE MANAGEMENT AND SUPER-COMPRESSION.

The paper by Mr. H. Dunell on "Engine-house Management," which was taken in the Committee Room at 10.45 a.m., under the chairmanship of Mr. F. H. Livens, dealt with the subject in two sections. The first was concerned with the losses which may take place in the conveyance of steam from the boilers to the engines, while the second referred to the maintenance of the engines themselves in an efficient condition. After pointing out the importance of attending to leaking pipe joints, and maintaining them in good condition by the reduction of unnecessary stresses in the pipes, the author touched on the relative merits of various classes of lagging material. He condemned steam traps as being, generally, more trouble than they were worth, and advocated the use of plug cocks in preference as a means of draining steam mains. With reference to the maintenance of the engines, he concentrated most attention on the condensing part of the plant, pointing out how important, in securing a good economy, was the maintenance of a high vacuum. Various suggestions were made as to the best means of scaling dirty condensers, including the use of acid and sandy water. The elimination of oil from feed water was another important matter, and the author suggested that electrolytic methods might be employed with advantage. He did not appear to be much in favour of the keeping of records, or log sheets, in power houses, but recommended the occasional organisation of running trials under working conditions and the periodical taking of indicator cards in the case of reciprocating engine stations. On the other hand, the maintenance of turbine plants need not, he said, give the engineer much anxiety.

The discussion which ensued was chiefly concerned

with the first part of the paper, several of the speakers agreeing that there are few really reliable steam traps, and making suggestions as to the best means of lagging steam pipes. In this connection Mr. Druitt Halpin gave an account of some experiments he had carried out on the efficiency of cork as an insulating material. One of the speakers described an installation in which three old Lancashire boilers, in series with a separator, were used to take the oil out of low-pressure steam, with entire satisfaction; while another said that an electrolytic system of removing oil from feed water had proved quite successful.

The next paper, by Mr. A. E. L. Chorlton, dealt with "Super-compression and other Means for Improving the Economy of Internal Combustion Engines." In it the author pointed out that nearly all the schemes which had been brought forward within recent times with the idea of improving the economy of internal combustion engines had been anticipated by other inventors a decade ago. The various means of extending the expansion ratio, while maintaining the maximum permissible compression ratio, such as the Atkinson link motion, compound cylinders, and so forth, were described, and the objection to compound working, caused by the troubles with valves controlling hot exhaust gases, was mentioned. A number of drawings was exhibited round the room to illustrate the different arrangements which had been tried for compounding gas engines, and it was suggested, later in the meeting, that they were of sufficient historical interest for inclusion in the "Transactions" of the Institution. The other methods of improving engines referred to by the author were the raising of the compression ratio by the introduction of inert gas into the cylinder, supercharging, stratified working, and the utilisation of the heat otherwise lost in the cooling water and the exhaust.

Apart from some rather startling particulars of a Krupp engine, given by Mr. Steinheil, the discussion was chiefly concerned with modifications of the orthodox type of engine, and not much attention was paid to the compound class. In the German engine just referred to an effort to improve the efficiency was made by raising the mean effective pressure up to as high as 200 lb. per square inch. Mr. Steinheil had got few particulars of the engine, but promised to try and get some more. The difficulties attending attempts to recover heat from the cylinder jackets were discussed, especially when the water temperature was raised above, say, 80 deg. Cent., and the possibility of improving scavenging by utilising the suction produced by the inertia of the exhaust was commented upon. Mr. Durtnall gave an explanation of the principle of the engine with which he is experimenting at Newcastle, for mountain railway work. In it the admission valve has a variable cut-off, like that of a steam engine, so that the amount, that is to say the weight, of the charge drawn into the cylinder, and consequently the compression, can be kept constant regardless of the density of the atmosphere, which naturally varies with the altitude.

THE EXHIBITION.

The exhibition of apparatus and models which had been arranged in connection with the Conference, with the object of showing what has already been done by manufacturers in the way of providing plant for the improvement of economy in power production, was principally staged in the main lecture theatre of the Institution. So generous, however, had been the response to the invitation for the loan of apparatus that the exhibits spread out into the hall, up the staircase, the window sills of which were dotted with models and the walls covered with diagrams, and down into the basement, where there was another collection. The interest which the exhibition had for the members and their friends was obvious, and it formed such a strong attraction that it was only at the last moment that the audiences took their places to hear the various papers read, while as soon as the discussions were finished the exhibition was crowded again.

There were well over a hundred exhibits all told, and it would take too much space to describe them in detail here. Many of them have already been dealt with in our columns. Quite a striking feature of the exhibition was the preponderance of appliances concerned with boiler-house service, as compared with engine-room work. There were all kinds of recording instruments and meters for dealing with coal, water, steam, air and carbon dioxide, thermometers, pyrometers, thermoscopes, pressure gauges, and so on. Oil fuel burners were well represented, mostly by full-sized examples, which were suitable for service in all kinds of furnaces, while there were several mechanical stokers represented, either in the form of models or of drawings. There was, of course, a model of an economiser, and an air heater, while several superheaters were shown.

AT a meeting of the proprietors of the London and North-Western Railway on the 4th instant the late Bill for taking over from the Ministry of Transport of certain piers, quays, &c., at Holyhead was approved. This Bill was drawn up in anticipation of the deepening of the harbour with a view to an acceleration in the handling of the mails.

The London Electricity Supply Problem.

No. IV.*

ALTHOUGH this inquiry is dragging on rather slowly, a little more rapid progress was effected during the past week. In our last article reference was made to the opening of the case for the scheme put forward by the nine London companies. That scheme has now been disposed of. It provides for giving a supply in an area represented by a circle having a radius of 10 miles, with St. Paul's Cathedral at the centre. In its engineering aspects it is the same as the schemes of the L.C.C. and the Conference of Local Authorities, but the few essential differences on what may be called the administrative side have caused a good deal of discussion. The foremost controversial point, perhaps, is the manner in which the undertakings of authorised distributors are to be purchased. Briefly put, the companies, so far as they are concerned, asked that their generating plant and transmission mains should be acquired by the Joint Electricity Authority to be set up in the area, on the terms of paying, either in a lump sum or by instalments, the cost of the plant as ascertained from the books, less depreciation on the Inland Revenue scale, plus a sinking fund to replace the plant when worn out. That is a straightforward statement of what the witnesses for the companies have asked for, but the scheme appears somewhat ambiguous in print; hence there has been much discussion.

The companies suggest that, as a condition for putting up a substantial sum, well over one million sterling, to finance the Joint Electricity Authority in its early stages, they should be granted an extension of their life as distributors for a period of fifty years after 1931, the date at which, as things stand at present, they will be purchased outright, both as regards generators and distribution, by the London County Council. In this suggestion the L.C.C. is inclined to agree, provided other matters are arranged satisfactorily. The reason why there has been so much discussion, however, concerning the proposed terms of purchase of the generating stations and transmission mains under the scheme is that the companies have asked that the generating stations, &c., shall be paid off on the basis of a yearly rental of 7 per cent. of the cost of the plant, as ascertained according to the arrangement set out above. It follows from that that the total amount so paid would be more than the figures of cost, and the Commissioners displayed anxiety to know precisely what is meant. The difficulty was introduced through the mention of the 7 per cent. rental. As the point was finally left, the companies asked for the cost of the plant less depreciation, the amount to be paid in a lump sum or by instalments.

An interesting engineering feature of the companies' scheme is the proposal to erect a generating station some few years hence next door to the works of the Gas Light and Coke Company, which company gave evidence, through its governor, Mr. Milne Watson, to the effect that it would be willing to grant a lease for ninety-nine years. The advantage claimed for this arrangement were that the electricity works would be a consumer of much coke that has now to be exported; that there are already existing ample coal-handling facilities, thus saving much capital expenditure, and finally, it would be a step in the public interest, because it would bring the electrical and gas industries into closer working. The obvious point was immediately raised by the Commissioners as to the wisdom of erecting public works of this character on leasehold land, seeing that the whole of the buildings would revert to the Gas Company at the end of the lease. It was agreed that it could all be arranged otherwise in the lease if it were thought necessary, although the fact that the buildings would remain with the lessees at the end of the lease would make a difference in the terms. Generally speaking, however, it was felt that ninety-nine years was such a long period that the point was not worth worrying about.

Following the consideration of the companies' scheme came the one promoted by the Poplar Borough Council for an area in the east and south-east of London, which has been termed the industrial area. This scheme differs radically from any of those previously presented. The foundation of it is that where an area has a sufficient demand to absorb the output of a capital station, it should be constituted a separate area and should have an independent Joint Authority or a Committee, acting under a Joint Electricity Authority controlling the whole of the area delimited by the Commissioners, which larger area might be divided into half a dozen smaller and financially self-contained other areas, such as the one proposed by Poplar. As already mentioned, the area takes in the whole industrial district in the east of London and crosses the Thames to take in those districts adjacent to the river from Woolwich to Gravesend. The outstanding feature, however, is that the promoters of the scheme have not the support of any of the authorised distributors in the area, except that of the promoting body, Poplar, and couns l for the scheme put it quite frankly to the Commissi ners that he could not in the circumstances ask the Commissioners to say that the area he put forward was a good one for a self-contained project of electricity supply, apparently in the hope that the authorised distributors in it will fall into line. At the moment, of course, there are arrangements for mutual supply between many of the authorised distributors in the area, but for the most part these authorised distributors are parties to the scheme already put forward by the Conference of Local Authorities.

* No. III. appeared July 1st.

Electrical Developments in Australasia.

A SURVEY of the national newspapers from day to day reveals the fact that throughout the length and breadth of Australia and New Zealand the expansion of electricity in nowhere more marked than in the smaller type of township. Shire and borough councils in all parts have taken steps, or are considering action, to install electric power plants. In many instances action has long since been taken.

Standing out above all other matters during the month of May last was the acceptance, by the Victorian Government, of a tender for £379,000, made by the International General Electric Company of United States, through the Australian General Electric Company, for the supply of transformers and switchgear for the extensive scheme undertaken at Morwell to generate and transmit electric power to Melbourne. No British tender for the whole of this portion of the equipment was, it is stated, received. Tenders for different sections of the work were received, it is understood, from British firms, but the price quoted by the successful United States company differed by nearly £300,000 from the lowest possible combination of British quotations.

The committee which was appointed some time ago by the Brisbane Metropolitan Water and Sewerage Board to consider the most efficient and economical scheme for supplying electric energy in bulk for sewerage purposes has reported in favour of the acceptance of the recommendation of the Government electrical engineer that transmission mains be run to transmit 700 kilowatts, the mains to be of such character that they would be suitable, without alteration, to convey current at a pressure of 22,000 volts instead of the proposed 5000.

The revenue from the Electric Supply Department of the Melbourne City Council for the year ended December 31st last amounted to £303,588, an increase of £63,507 over that of 1919. The general expenditure amounted to £187,338, and the gross profit was £116,249, the net profit being £38,976. The last named constitutes a record in the annals of the Council.

Tenders, closing on August 17th, are being invited by the Shire of Hampden, in Victoria, for boiler-house plant, steam electric generators, transformers, meters, switchgear, &c. The capital of the Electric Energy Supply Company, Limited, Warwick (Queensland), is to be increased from £12,000 to £20,000 to provide for additions to the power plant.

A scheme of some magnitude has been undertaken in connection with the supply of power to Wellington, New Zealand. It is hydro-electric, and the Mayor of Wellington recently expressed satisfaction with the progress which is being made. The power from the source—the Mangahao—will be derived by damming two small rivers, about one mile apart, and connecting them by a tunnel 7ft. in diameter, cut through a hill. The water will then be carried by a second tunnel driven to the face of the hill facing Shannon, and then by pipe lines to the power house, 900ft. below. Approximately 24,000 horse-power will be generated, 12,000 of which will be transmitted to Wellington City.

Outside Wellington itself, the town of Lower Hutt is discussing a plan to provide a special hydro-electric supply by utilising the Mangaroa River and bringing current into the town at a pressure of 11,000 volts. It is estimated that the demand will grow from 125 horse-power in the first winter to 380 horse-power in the fourth, increasing by 75 yearly thereafter till the demand is satisfied. According to plans prepared last September, the estimated capital cost would be:—Power station, £37,706, and distribution system, £29,891; but owing to changing conditions in the world's markets some revision of this estimate would now be necessary.

The city of Christchurch, New Zealand, has been authorised to borrow £98,000 for the distribution of electricity, and the Commonwealth Bank of Australia has agreed to advance £10,000 to the Stephens Shire Council in Queensland for the purpose of installing an electric light service in the shire.

The electricity venture of the Dunedin, New Zealand, City Corporation appears to continue successful, in view of the fact that the profits for the past twelve months amounted to about £20,000, an increase of £2000 on the previous year's returns.

The residents of the Grafton district in northern New South Wales are urging the authorities responsible to push on with the Nymboida hydro-electric proposal. The acceptance of tenders received in January last for a portion of the plant was held up owing to the financial stringency.

The New Zealand Public Works Department has accepted the tender of S. Green, Limited, Sydney, amounting to £26,377, for the supply of copper cable in connection with the Waikato hydro-electric power undertaking.

DURING the month of April—the first of the coal stoppage—the passenger train mileage was, as compared with March—reduced by 20.38 per cent. The number of passengers was 16.48 per cent. less. The tonnage of merchandise, as compared with April, 1920, was 24.35 per cent. less, and the ton-miles 26.13 per cent.; the tonnage of coal, coke and patent fuel 89.70 per cent., and the ton-miles 91.16 per cent. less; the tonnage of other minerals was 50.57 per cent., and the ton-miles 54.65 per cent. less. The total tonnage of goods was 67.01 per cent., and the ton-miles 62.08 per cent. less.

A Seven-Day Journal.

Channel Tunnel.

THE advocates of the Channel Tunnel are growing in number, and the Channel Tunnel Company has, in view of this fact, built a new boring machine in the hope that the works may be authorised at an early date. In the first instance, it was intended to make experiments with this machine on the cliffs at Dover, but Sir Robert Perks has suggested that the proposed boring tests should be carried out as part of a trial heading. Sir Robert also expressed the belief that the Channel Tunnel Company might expect assistance in the preliminary work from the Northern of France and South-Eastern Railways. Those interested in the tunnel have now to take into account the threatened diversion of traffic to train ferries operating from the port of Richborough, and the fact that the French Government is spending a large sum of money in deepening the channel of the river Seine up to Paris, which must tend to encourage the flow of traffic by water.

Improvement in Ship Design.

A MODIFIED form of design for the double bottom of ships has been submitted by Sir Westcott Abell, the chief ship surveyor to Lloyd's Register, to the General Committee of the Society. This design is based on the fact that the strength of the double bottom required to meet local conditions is usually considerably in excess of the duty it is called upon to fulfil as part of the main structure, particularly when the lower part of the vessel is in compression. Many attempts have been made to lighten the construction, and special attention has been given in this design to a reduction in the amount of cross connection between the top tank and the outer bottom plating. Many believe that it might be possible to dispense entirely with solid floors, but it is thought preferable for several reasons not to proceed to this extreme. A model, in which the features of this design are incorporated, has been submitted by Sir Westcott to his Committee.

Electric Propulsion of Ships.

THE rumours in regard to experiments to be carried out with electric propulsion in American-built merchant vessels are now confirmed. It is reported that the United States Shipping Board is fitting two ships and the Cosmopolitan Steamship Company one vessel with electrical transmission machinery in substitution for the geared turbine. The largest of these vessels, the Invincible, is of 7888 gross tonnage, and is a steel cargo vessel. It is understood that a number of other merchant ships are to be equipped with the electric drive in order that a complete test under ordinary service conditions may be made of this system in comparison with the geared turbine.

British Firm's Successful Tender.

IT is good news, having regard to the difficulty with which British engineering firms are placed in quoting competitive prices for work offering, that a London firm has obtained the contract from the Victorian Governments for the steel towers for the main transmission line of the Morwell power scheme. This scheme, which is estimated to cost £2,000,000, is the most important yet planned for Australia, and it is satisfactory to learn that the English tender for the steel towers was well below the lowest Australian quotations. The exact figures were £72,858 against £96,108.

London University Site.

THE agitation on the subject of the site for the extension of the University of London has not yet died down. At the annual Assembly of Faculties of University College it was stated that the Senate had accepted the offer by the Government of a site of 11½ acres to the north of the British Museum. This site would, said Professor Sherrington, be used primarily for the erection of a Senate House and the removal to it of King's College. On the same day the subject came up before the London County Council on a recommendation from the Education Committee that the possibilities of the Holland Park site of 35 acres should be further explored before proceeding with extensions on the Bloomsbury site. It is perhaps now too late, however, for the decision of the Senate to be changed, but in spite of this consideration the Committee's recommendation was adopted.

British Oil Policy.

AN interesting memorandum has been prepared by the Petroleum Department dealing with the general situation in regard to oil supplies. The main object of this document, it has been explained by Lord Curzon, in transmitting it to the American Ambassador, is to dispel the belief which has found credence in certain quarters that the British Government is co-operating with commercial interests to secure an undue share of the petroleum resources of the world. It is pointed out that next to the United States, Great Britain is now the largest consumer of oil in the world. Over 90 per cent. of the ships composing the Navy use oil as fuel, and an increasing percentage of mercantile vessels are now oil-fired. Great Britain imported last year nearly 3½ million tons of oil, and her present home oil resources represent about 165,000 tons a year. Even if the whole output of the British Empire were included, the output would represent only a small percentage of our requirements, but in spite of this fact, there is no general policy of exclusion of foreigners. It is pointed out that in the United States, which at present produce two-thirds of the world's output, the foreign-owning element is small. This memorandum should dispel the idea that there is any intention on the part of the British Government to support a policy of creating a British monopoly in the newer fields.

Railways Bill Muddle.

THE attempt to rush through the House of Commons, without adequate discussion, a complicated and controversial measure like the Railways Bill has evoked strong resentment in trading circles. A letter of protest against the limitation of discussion has been addressed to Sir Eric Geddes on behalf of some of the leading trade organisations. It is signed on behalf of the Federation of British Industries, National Association of Iron and Steel Manufacturers, Association of British Chambers of Commerce, Mansion House Association, and the Traders' Traffic Conference. The communication puts on record the belief that under the procedure to be adopted the Bill will be an unsatisfactory measure and contrary to public interest. The fault for the lack of time to introduce the necessary amendments rests with the Government, which delayed the introduction of the measure to a date when it was obvious there would be great difficulty in passing the Bill through all its stages during the present session. There will be general regret that the reorganisation of the main transport system of the country is to be the subject of hasty legislation.

Empire Communications.

FACILITY of communication is the strongest link of Empire, and it is good news that as the outcome of a discussion at the Imperial Conference a strong Committee is to be appointed to consider the question of the practical means available for the development of Imperial communications by land, sea, air, cable, radio-telegraphy and telephony. In this work it is clear the engineer must take an important part. It is he who will be responsible for the higher speed of ships on Empire routes, for the improvement of docks and harbours, for the development of air services, and for the advance to the point of commercial operation on a vast scale of wireless methods of bridging the gaps which separate the component parts of the Empire. The wireless chain is making progress; the Oxford-Cairo link will be in operation by November next, and with regard to air services Mr. Churchill believes that services on the Karachi-Baghdad-Cairo route should be started in the near future. A machine has already flown from Cairo to Baghdad in eleven hours against a journey by other methods of from 4½ to 5 weeks. An era of progress in Empire communications and transport far transcending any previous development is clearly in sight.

A Trade Exhibition Ship.

IMPORTANT shipbuilding interests, which include Sir George Hunter, are represented on a company which has been formed to acquire a ship with which it is intended to make an exhibition of British manufatures. It is stated that the ship will present special features of design to enable a good display to be made of British goods, and that the plan of operations will be to send the ship on a world tour, during which a stay will be made at the principal ports and prospective customers invited to visit the vessel. It is assumed that the vessel will be built by Swan, Hunter and Wigham Richardson, Limited, and the experiment will be watched with considerable interest.

Damage to Government Airships.

WHAT has happened to the L 64 and the R 36 is not calculated to encourage the taking over of the Government airship fleet by commercial interests. It is admitted that the first-named airship is now a complete wreck, and that somewhat serious damage was inflicted on the R 36 in the attempt to land her at the Pulham mooring mast. A certain portion of bow girder work crumpled, a number of girders on the port side amidships were broken, and a number of girders on the starboard side forward bent. The damage to the bow girder work occurred during the process of landing. The significant feature is that owing, it is said, to the limitations both of time and money imposed on the present experiments, a cheap form of winding gear was employed in place of the reversible winch gear, by the use of which the accident might have been avoided. The Minister of Air has stated in reply to questions in the House of Commons that the Government intends to pursue its policy of discontinuing the development of rigid, semi-rigid and non-rigid airships.

Retirement of Professor Wemyss Anderson.

AFTER eighteen years' service at Liverpool University, Professor J. Wemyss Anderson, who holds the position of Dean as well as that of Hughes Professor of Engineering, is about to retire from the first-named office. The news has been received with regret, as during his tenure of the Deanship Professor Anderson has done much to develop the faculty of engineering. He began his career under Professor Hele-Shaw at University College, and during the war period, owing to his position as an authority on refrigeration, became technical adviser to the Food Controller in cold storage matters. It was in the year 1819 when Mr. T. Harrison Hughes made a gift of £50,000 to Liverpool University that a chair of engineering, with special reference to refrigeration, was founded, and it was natural that Professor Anderson should be appointed to this chair. He is retiring from the position of Dean of the University in order to devote himself more entirely to cold storage questions.

Power Alcohol and the Law.

WITH the object of obtaining the removal of certain restrictions and duties which, it is asserted, prevent the free supply of power alcohol or mixtures thereof to consumers in the United Kingdom, a deputation from the British Empire Producers' Organisation has waited on the Chancellor of the Exchequer. The belief was expressed in arguing the case for an amendment of the law that the duties were never intended to apply to power alcohol, which at least, when intended to be used for mechanical transport or power requirements generally, should be admitted free. In the case of mixed alcohol fuels, manufactured overseas and imported in a state ready for use, a request was made for a substantial preference on imports from the Dominions. Figures were quoted on the result of tests carried out by the London General Omnibus Company, which showed that power alcohol could not compete with petrol unless it were imported free of duty. The Chancellor of the Exchequer, in reply, stated that there had always been higher duties on imported alcohol than on the home-produced spirit on account of the excise restrictions which imposed a special burden on home manufacture. He also referred to the complexity of the whole subject, and the deputation only secured the meagre satisfaction that the whole subject would be reconsidered.

A High-Muzzle Velocity Gun.

A SOMEWHAT sensational story of what is termed a noiseless, smokeless weapon with a muzzle velocity of 5 miles per second has been cabled from New York by correspondents of the daily Press. In appearance, we are told, the new gun resembles a pneumatic tool having a barrel 8in. long, with a muzzle of 1in. diameter. It is said to be capable of driving slugs fitted with screws 3in. long into a steel plate with such force that each requires a pressure of 8 tons to extract it. Dr. Hutchison, who, it will be recalled, was formerly one of Thomas Edison's chief engineers, suggests that the gun could be enlarged to a degree which would enable it to discharge projectiles weighing 5 tons a distance of from 200 to 300 miles, and thus completely eclipse the performance of the German long range guns. The secret of the principle involved is not disclosed, but the essential mechanism is said to be concealed in the inner cylinder of the gun or tool. One gathers that the inventor is not anticipating the use of the gun as a weapon of war, but Mr. Hudson Maxim has predicted considerable application for it in industry.

Dublin University War Memorial.

A SUM of between £5000 and £6000 having been subscribed for a Dublin University War Memorial, plans have now been made as to the form the memorial shall take. A Hall of Honour is to be built in connection with a Reading Room for the Library, and a design has been prepared by Sir Thomas Deane and approved by the Executive Committee and by the Board of Trinity College. A much larger sum than that which has already been subscribed will be required, but it is hoped that the necessary amount wil be forthcoming. The Gold Medallists' War Fund, which has no connection with the official college memorial, now amounts to over £1400, and is to be used to assist in educating the sons and daughters of the Trinity men, to the number of 450, who fell in the war.

The Royal Show at Derby.

No. II.*

A VERY comprehensive stand was that of Davey, Paxman and Co., Limited, Colchester, whose exhibits included a locomotive type boiler, a 50 horse-power gas engine, a wood refuse gas producer, a quarter-scale model of a tandem compound condensing engine, and a horizontal steam engine. We have selected for illustration the 50 horse-power gas engine—Fig. 12—and the gas producer—Fig. 13. The engine is of the horizontal pattern, with a cylinder 12½in. diameter by 19in. stroke, and the normal speed is 220 revolutions per minute. It has a single fly-wheel 7ft. diameter by 9in. wide on face, and a driving pulley 45in. diameter by 15in. wide. As usual, the cylinder jacket and bed are cast in one piece, so that practically the whole of the cylinder is supported, the only slight overhang being in the combustion chamber itself. The combustion chamber has been designed so as to expose the minimum amount of surface to the action of the flame, and there are no pockets or corners. An outer bearing with a pedestal is provided beyond the fly-wheel. An oil trough is cast round the bed-plate to catch the waste oil. The valve gear is arranged for qualitative governing, that is, the governor acts upon a throttle which varies only the quantity of gas admitted, thus varying the strength of the mixture, but leaving the volume of the charge fairly constant, and securing practically the same compression at all loads. The air and gas valves are concentric. This system, the makers state, has proved very satisfactory for engines used for electrical work, a very close governing being obtainable. The ignition of the charge is effected by means of a low-tension spark from a magneto, the timing of the spark being controlled by a small quadrant. The lubrication of all the wearing parts has been carefully provided for. The main bearings, which are of the four-part type, and the outer bearings have chain lubrication, which, it is stated, enables the oil supply to be replenished without stopping the engine. The piston is supplied with oil from a small oil pump driven from the side shaft, by which means the exact quantity of oil necessary is pumped to the piston at the proper moment. The small end of the connecting-rod is independently lubricated. The skew gearing is machine-cut, and runs in an enclosed oil bath.

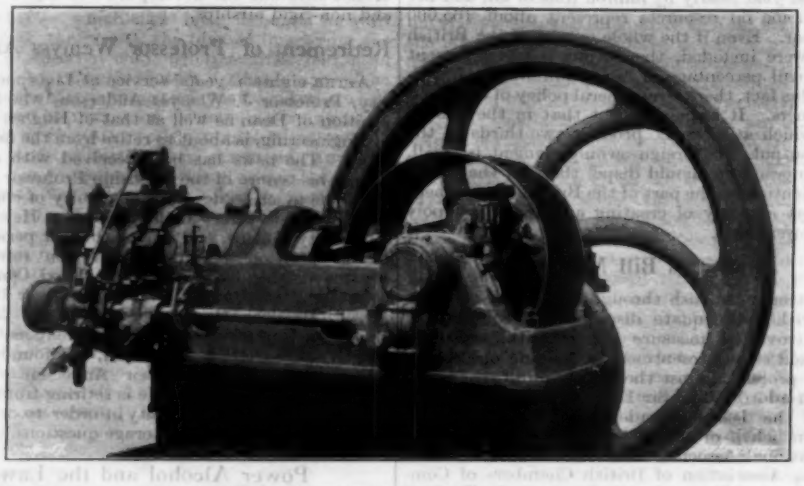


FIG. 12—DAVEY, PAXMAN 50 HORSE-POWER GAS ENGINE

The wood refuse gas producer—Fig. 13—exhibited by the same firm, is of the makers' latest design. The generator body is built up of mild steel plates, closely riveted to ensure gas-tight joints. The brick lining is solid from the cast iron dead plate to the top of the generator. The fuel feeding hopper is so constructed as to prevent the admission of any air to the generator whilst charging is taking place. The generator doors close against machined faces. There are no loose cross bars or wedges in connection with them, a malleable iron hinge carrying the door, which is kept tight by central pressure, and is secured by means of a wing bolt. The cooling chambers consist of three vertical pipes in series fitted with the makers' adjustable spray valves which regulate and spray the water required to cool and clean the gas. The third cooler is coupled direct to the tar extractor. Any matter drawn over is washed down into the seal pit by the jets from the sprayers.

A vaporiser is supplied when it is desired to provide for the operation of the plant with anthracite, coke, &c., as an alternative to wood refuse in case of a failure of supply. These latter materials do not contain enough moisture in themselves, and make the use of a vaporiser imperative in order to supply the necessary steam for the chemical heat reaction within the generator. This vaporiser replaces the first of the three cooling chambers, being similar in its main outlines, but of modified design internally. Hand hole and cleaning covers are provided on the cooling chambers, and poking holes are arranged on top of the producer. The tar extractor is of the centrifugal type, and is fitted with ball bearings. The gas, in passing through the centrifugal extractor, acquires a rapid whirling motion, which separates out the tarry matters and other impurities in the gas. The sawdust scrubber is a cylindrical chamber fitted with wooden grids carrying a good depth of sawdust between layers of wood shavings, through which the gas is drawn, thereby being further cleaned, dried and purified.

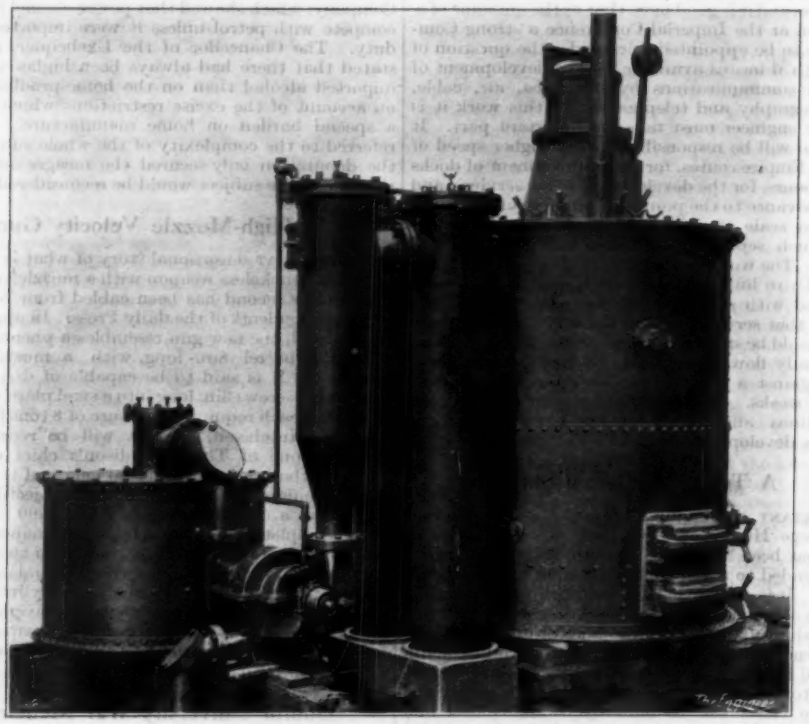


FIG. 13—DAVEY PAXMAN WOOD REFUSE GAS PRODUCER

Robert Boby, Limited, exhibited the Boby "hedgehog" harrow, illustrated in Fig. 14. It has been designed to meet the requirements of the farmer for preparing seed beds and for summer fallowing. The machine is of strong steel construction, and each wheel is fitted with fourteen spikes, which are set at a slight angle from the vertical. The hub of the wheel is made in two halves, in which recesses are cast for the spikes, and the two parts of the hub are bolted together. When the machine is used with a tractor an adjustable drawbar can be supplied to fit in place of the swivel front wheels, the change only requiring the removal of two bolts. Heavy steel scrapers are fitted to each of the spiked wheels.

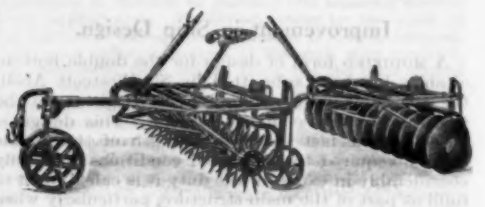


FIG. 14—THE BOBY "HEDGE-HOG" HARROW

Robert Boby, Ltd., also exhibited a flax-scutching machine, which is used for separating the fibre from the straw, which has, until very recently, been performed solely by the aid of scutching wheels or stocks. The mechanism consists of a revolving frame in which are carried six scutching cylinders, each being provided with a number of steel blades. These six cylinders, by means of a sun and planet gear, are caused to revolve at considerable speed, at the same time being carried round by the revolving frame in which they are mounted. Under the circular path of these cylinders is a fixed grid, concave in form, with longitudinal blades of a similar nature to those in the cylinders, and as the cylinders travel over the grid both sets of blades work in mesh as do gear wheels, and it is by the introduction of the flax between the fixed and revolving or rolling blades that the shieve is stripped from the fibre and falls underneath the machine, whence it can be taken away by means of a conveyer, or bagged up direct. An endless and reversible band is also provided for feeding the flax into the breaking rolls and scutching mechanism, this feeding band being reversible and having a neutral position. In operating the machine, the flax straw is laid on the conveyer band, which, travelling forward, introduces the straw between the breaking rolls and thence between the fixed and revolving blades of the scutching mechanism until about three-quarters of the entire length of flax has been treated. Then, by reversing the band, by a simple clutch gear, the straw is withdrawn and turned over on the coveyer, which again moves in a forward direction, introducing the opposite end of the straw to the action of the break rolls and scutcher. Thence it is withdrawn in the form of clean fibre. It is claimed that the machine will work perfectly on any class of flax, and the flax can receive as much or as little scutching as the operator deems advisable, while the distance apart of the revolving cylinders and the fixed grid can be regulated very easily according to requirements. Every bearing on the machine is a ball bearing, which require no oiling whatever, as the housings are packed with grease. The machine requires a floor space of only 6ft. by 4ft. The makers claim a great saving of labour and power with this machine.

Walker Brothers, Limited, Wigan, makers of the Pagefield commercial vehicles, exhibited a specially short wheel-base tipping wagon. This wagon has been designed to meet the needs of municipal engineers and others who require a vehicle capable of working in restricted spaces. To make it suitable for this purpose it has been made as short as possible by arranging for the driver to sit alongside the engine. A generous steering lock is provided for the front wheels, and the track of the rear wheels has been made narrower than that of any vehicle of ordinary type. This wagon is illustrated in Fig. 15. The engine fitted is of the Dorman subsidy type having four cylinders 120 mm. bore by 140 mm. stroke. It gives 38–40 brake horse-power at 1000 revolutions per minute. The gear-box gives four speeds forward and reverse, and the final drive is by worm and wheel. The wagon has a speed of 16½ miles per hour at an engine speed of 1000 revolutions

* No. I appeared July 1st.

per minute. The vehicle is fitted with a mechanical tipping gear, which has a telescopic screw actuated by enclosed gearing from the gear-box to raise the body. The tipping gear has an automatic control which puts the mechanism into neutral at the top and bottom of the lift in such a way as to do no damage. The gear can be handled by the driver alone, and the special controls adopted make the tipping gear quick, safe and fool-proof. The makers state that full load can be tipped to an angle of 60 deg. in under one minute. The capacity of the body

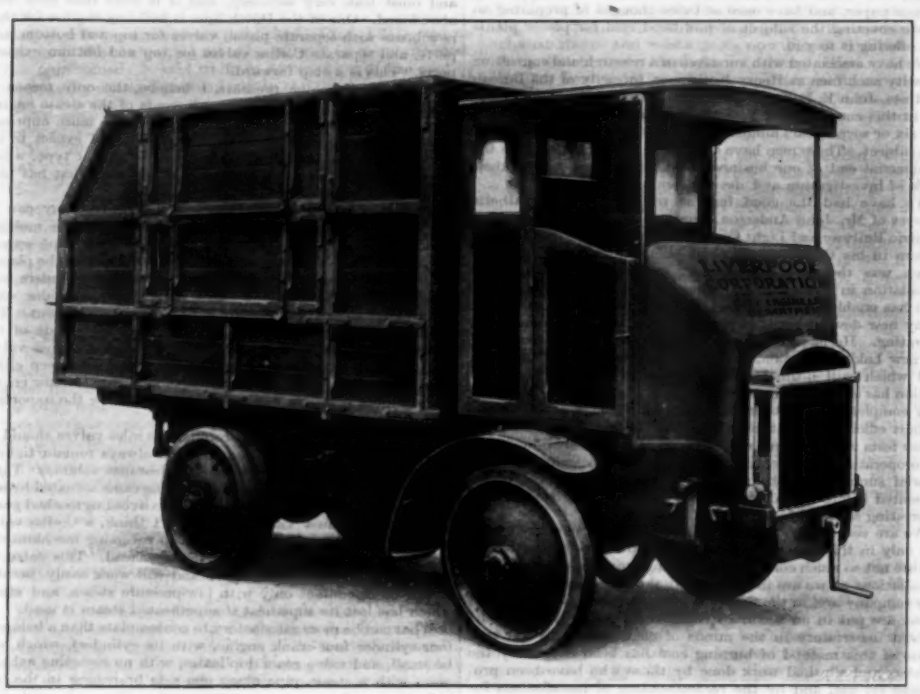


FIG. 15—WALKER BROTHERS SHORT WHEEL-BASE TIPPING WAGON

is 255 cubic feet, and the weight of the chassis about 3 tons. It has a wheel-base of 8ft. 2in. and a front track of 5ft. 7in., and rear track of 4ft. 3½in., and the complete vehicle will turn in a radius of 18ft.

Commercial Cars, Limited, Luton, exhibited a 2-ton lorry. It has a 25 horse-power four-cylinder internal combustion engine of 100 mm. bore by 120 mm. stroke, and is fitted with a gear-box giving three speeds forward and reverse, operated by a side lever through a gate change quadrant. The final drive is obtained by an overhead steel worm and worm wheel on a floating back axle.

As a labour-saving device in connection with the farming industry, one of the most interesting exhibits in the implement section was to be seen on the stand of the International Harvester Company. It consists of a somewhat complex attachment called a grain "stooker," which can be attached to a self-binding harvester, and is intended to dispense with the labour necessary for erecting the sheaves of corn after the binder has performed its part of the work. The stooker is attached to the rear of the binder, and co-operates with it to stook the corn while the binder is in motion without any interruption to its progress across the field. The grain stooker is somewhat similar in construction to the binder, but the movements introduced are entirely new. As the bundles are tied and discharged from the binder deck they engage mechanism which actuates a fork and carries the bundles to the stook setter, the stooks comprising seven to eleven bundles. As the fork moves backwards and forwards it carries the bundles to two positions in the stook setter, alternately depositing the bundle first on one side and then on the other with the lower ends spread and the tops overlapping to make a vee-shaped structure. These movements of the fork continue until there are enough bundles in the centre to make the desired size of stook. The bundles are then compressed and tied together with twine in much the same manner as that used on the binder. The stook setter is wider at the rear than at the front to assist in making the stooks stand firmly when discharged. It is provided with an inclined bottom, which is pivoted to enable it to tilt to the rear and discharge the stook after it is compressed and tied. The arm under the stook setter has a roller at the end which comes in contact with the stook setter bottom. This arm is rocked in such a way as to tilt the bottom of the stook setter with a quick movement, which sets the stooks squarely upon the ground. When the stook setter tilts to discharge the stook, two tines spread the butts of the back and corner bundles to give the stook a substantial base.

One of the most interesting exhibits in the motor vehicle section was to be seen on the stand of Tilling-Stevens Motors, Limited, Maidstone. It consists of a 4-ton petrol-electric chassis with a tipping body which is operated electrically, the electric motor which normally propels the vehicle also serving to operate the tipping gear. The electric tipping gear is self-contained, the dynamo and motor which propel the vehicle being used for operating the body. No extra reversing switches or starting rheostats are required, the same controller and resistance used for travelling being used to operate the body. This obviates the use of additional switchgear and also of an extra electric motor usually of small power and liable to burn out if an extra heavy load is taken. The operating lever is placed on the dashboard opposite the driver, and may be operated without leaving his seat. At the rear of the motor is mounted an extension shaft and a gear wheel, which also forms a clutch. This clutch disconnects the motor from the propeller shaft. The gear wheel of the clutch slides on a spindle shaft and meshes with a gear wheel keyed to the driving screw of the body. The driving nut is supported on two steel channels, thereby taking all stress off the screw. An entirely automatic switch is provided to prevent over-winding, and is connected in such a manner that the circuit to the motor is broken near or at each extreme movement of the body, and at any intermediate position the body may be moved to in either direction.

Robey and Co., Lincoln, exhibited a 5-ton steam wagon fitted with rubber tires. This wagon has been entirely re-designed, and it is claimed by the makers to be the lightest over-type wagon on the market, and probably the only one which complies in all respects with legal requirements. Both the front and back axle weights come well within the limit allowed by the law; the front axle weight of the standard wagon with fuel and water and 5-ton load on standard body being 3 tons 13 cwt. 3 qrs.; the hind axle weight, 7 tons 11 cwt. 2 qrs.; giving a total of 11 tons 5 cwt. 1 qr. The position of the driver is such that his view of the road both in front and at the sides is unimpeded. The wagon is under perfect control of the driver, having powerful foot brake fitted to both hind wheels, so that in emergency the driver's hands are both free for controlling the vehicle. All levers are within easy reach, so that it is possible for the wagon to be driven and controlled by one man. The boiler is of the locomotive type, of somewhat novel construction, and no stays are used. There was also being exhibited a 3-ton trailer weighing only 30 cwt., with rubber tires. This trailer can be supplied with any kind of body, tipping or non-tipping. The frame and fore-carriage are built up of mild steel channels, and the wheels have pressed steel centres and cast iron naves. The brakes can be operated either from the wagon or trailer.

Amongst the other exhibitors of steam wagons and tractors were Leyland Motors, Limited, Leyland; Richard Garrett and Sons, Limited, Leiston; Fodens, Limited, Sandbach; Clayton and Shuttleworth, Limited, Lincoln; William Foster and Co., Limited, Lincoln; The Sentinel Wagon Works, Limited, London; William Allchin, Limited, Northampton; W. Tasker and Sons, Limited, Andover; Mann's Patent Steam Cart and Wagon Company, Leeds; Ransomes, Sims and Jefferies, Limited, Ipswich; Yorkshire Commercial Motor Company, Limited, Leeds; Marshall, Sons, and Co., Limited, Gainsborough; and Atkinson and Co., Preston. With the exception of the engine shown by Ransomes, all the above-named machines are already well known. Ransome's is an "overtype" wagon, with a boiler of the locomotive pattern and circular fire-box built up of four plates without stays. Pressed steel brackets and mountings for supporting the engine are riveted to the boiler shell to ensure alignment, lightness and rigidity. The wagon frame is of pressed steel of deep section to give strength without undue weight. The engine is of the compound type, with two central discs on the crank shaft instead of an outside fly-wheel. A water heater is provided, and all the levers and steering gear are easy of access by one man.

The Ruston compound steam tractor is constructed to come under the Heavy Motor Car Act, and is suitable for hauling a gross load of 7 tons. Both front and hind axles are mounted on laminated steel springs. The cylinder is mounted upon a planed steel seating, which is riveted to the boiler; thus no bolts from the cylinder enter the steam space. The crank shaft and first countershaft run in adjustable bearings. The second countershaft runs in a "Cannon" bracket, which connects the two horn plates, making a rigid job, and preventing springing of the horn plates. The first countershaft is square, thus dispensing with unsatisfactory keys and feathers. The clutch gear is of the interlocking type, one lever operating both speeds, and it is impossible for both gears to be in mesh at the same time. The two speeds are 2½ and 5 miles per hour. The feed pump is within easy reach of the driver, and is of the continuous action

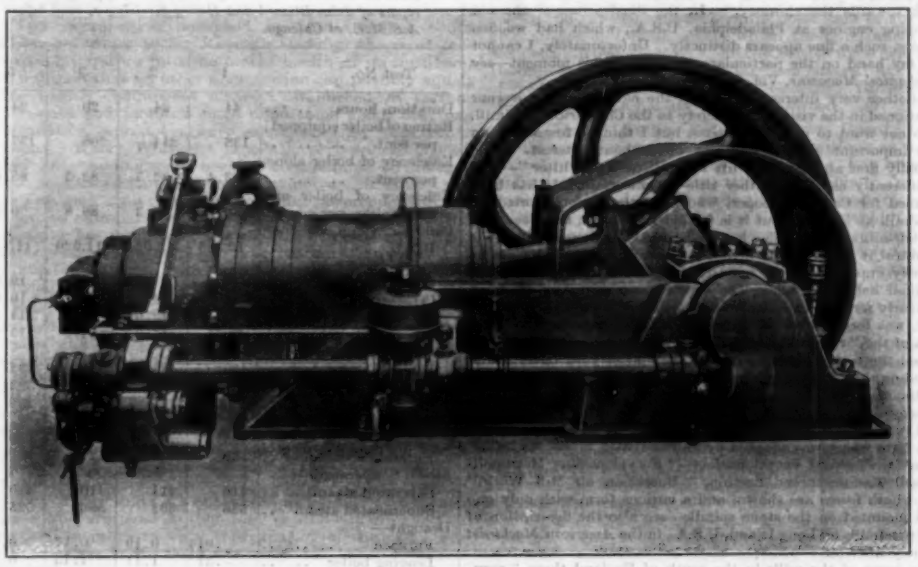


FIG. 16—FIELDING AND PLATT 55-H.P. HORIZONTAL SOLID INJECTION ENGINE

type, the water not required for the boiler being returned to the tank. Thus the pump and pipes are at all times full of water, and the pump will start instantly. The boiler is constructed throughout of Siemens-Martin mild steel plates on the most approved lines, and ample heating surface is provided. The reversing gear is of the link motion type.

Prominent features of the exhibits of Fielding and Platt, Limited, Gloucester, were two horizontal four-cycle hot-bulb crude oil engines with solid injection. These engines are designed for loads of 55 and 35 brake horse-power respectively. The larger engine is illustrated herewith—Fig. 16. It has a

girder bed to support the cylinder, variable governor, separate water chamber at the breech end, forced lubrication to the crank pin, ring lubrication to the main bearings, and balanced cranks. The amount of power developed is regulated by the governor in the following manner:—The oil injector is fitted with a cut-off valve, which is controlled by the governor, so that the oil is cut off earlier or later in the stroke according to the load on engine. The atomiser is merely a plain hole fitted with a non-return valve of simple construction, no complicated spraying device being necessary. The oil injector consists of a pump actuated by a quick-acting cam. This delivers the oil at high speed to the atomiser. The speed of engine is controlled by means of a centrifugal governor actuating a sleeve valve on the oil injector. The valve-box is fitted with covers for inspection purposes. The back end joint is entirely protected from heat and water, and is claimed to be practically indestructible. The valves are of the mitre type of large area. The exhaust valve is fitted with a renewable guide which is specially lubricated. The inlet valve is of mild steel, and it seats in a cast iron housing, which is fixed above the exhaust valve. The cam shaft is driven off the crank by means of spiral gear wheels working in cast iron guards, which also serve as an oil bath. The cam shaft is carried in three gun-metal bushed bearings. All the valves are easily accessible for cleaning or grinding.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE STUDY OF THE PAST.

SIR,—In common, no doubt, with many others, I have read with the greatest interest the reports of the proceedings of the Newcomen Society—to whom the greatest praise is due for their efforts to preserve the records of our early engineers—and likewise your able review of Commander Robertson's valuable book. I do not want to take up your valuable space, but I should like to call your attention to the fact that Messrs. Heaton—it is no doubt the same firm visited by the Society—built a very successful steam carriage in 1833, driven by spur gearing—see the *Mechanics' Magazine*, vol. 19, page 417, also page 240. The illustration unfortunately is a very poor one, and the details are much involved. Mr. Roberts, so celebrated in connection with cotton mill machinery and machine tools—Messrs. Sharp, Roberts and Co., afterwards Sharp, Stewart and Co.—who divides the honour with the French inventor Pequeur of first applying compensating gear to road locomotives, built a very fine steam carriage in the same year, with which a speed of nearly 20 miles was reached on the level. It would be most interesting if some particulars and illustrations could be secured of both these carriages. Fletcher, in "Steam on Common Roads," mentions both, but there are no illustrations except of the compensating gear, which shows outside cranks for a direct-connected engine. Hill, of Deptford, used the gear also, but that was later. The illustration is not clear, but if Hill's carriage was direct acting it appears evident that outside cranks were not used.

While on the subject of steam, Tomlinson, in the useful old work published in 1851, "The Cyclopædia of Useful Arts," vol. II., page 74, states "Watt sometimes added to the waggon boiler a *square* flue running from the end farthest from the fire back towards the chimney." In the illustrations of the old pumping engines at Philadelphia, U.S.A., which had wooden boilers, such a flue appears distinctly. Unfortunately, I cannot lay my hand on the particulars of these at this moment—see *Mechanics' Magazine*, Vol. 43, page 119.

Another very interesting item is the old windmill governor mentioned in the visit of the Society to the Chesterton windmill. I do not want to unduly trespass, but I think a few words on this important subject will not be without interest. Who actually first applied the "lift tenter" or "tent lifter"—it is indifferently called by either title—is uncertain. It has been claimed for Captain Hooper, who built the curious horizontal windmill at Margate, but it is far older. Meikle, the clever old Scotch millwright, is also believed to have the credit, but it is doubtful if it is not far before his era, although doubtless he greatly improved it. It may not be generally known that the original had four balls. The construction was very crude in the early forms. The governor arm, that is the rod carrying the ball, was forged with an eye which slipped over the horizontal arm of the "runner," which slid on the millstone spindle. This raised the forked lever known as the "steel yard bar," which acted on the end of the "bridge tree" carrying the step bearing of the millstone. Sometimes three balls were used, but later improvements separated the governor from the millstone spindle and reduced the number of balls to two. It is, of course, this last form which was adopted by James Watt.

In the older encyclopædias—"Encyclopædia Metropolitana," Manufacturers' Section, "Buchanan on Mill Work," &c.—both forms are shown, and a curious form with only one ball mounted on the stone spindle—see also the description of the windmills on Long Island, U.S.A., in the *American Machinist* some years ago.

In some of the mills in the south of England these "regulators," as they are there called, exist in very curious forms. Often the governor arms are cut with a screw thread that the balls may be raised and lowered with the view of making the governor more sensitive. The form of the "ball" is often very curious, sometimes like a flattened sphere, sometimes a pear—this is very common—and sometimes like half a Dutch cheese. The writer has seen at least two instances, one of which is still in use, where nearly the whole of the "regulator" is of wood, the balls, of course, excepted.

Returning once more to steam, and *apropos* of the great beam engine at Winfield's rolling mill, the writer's father well remembered seeing a very old beam engine at work at Barcombe oil mills, Sussex, where the fly-wheel was on the second motion shaft. The beam of this engine was, like some of Watt's older engines, composed of a solid baulk of timber. This engine, unfortunately, was destroyed when the mill was burnt down. It may also not be generally known that one of Watt's early engines—of more modern design however—is still at work at Messrs. Cobb's brewery, Margate.

By the way, Tomlinson gives Watt the credit of hollowing both the sides and bottom of the old wagon boilers for the double purpose of increasing heating surface and for strength, on the ground that an inwardly curved surface required little staying.

This letter has run to a great length, and I must apologise therefor, but the importance of the subject is my excuse.

SIDNEY RUSSEL.

Cranbrook, July 4th.

POWDERED COAL FUEL.

SIR,—We have noted, from time to time, articles appearing in your paper, and have once or twice thought of preparing an article covering the subject of powdered coal for power plants and offering it to you.

We have associated with ourselves in a research and consulting capacity such men as Henry Kreisinger, formerly of the Bureau of Mines, John E. Boll, a consulting engineer of very high standing in this country, and V. Z. Caracristi, who has devoted the last six or seven years almost exclusively to the development of this subject. These men have absolutely no connection with the commercial end of our business, and are unhampered in their work of investigation and development.

We have had the good fortune to have the sympathetic interest of Mr. John Anderson, chief engineer of the Milwaukee Electric Railway and Light Company, who installed the Lopulco system in his Oneida-street plant about three years ago, and which was the first commercially successful powdered coal installation in this country. This interest on Mr. Anderson's part has enabled us to conduct many investigations and make many new developments in a plant actually and commercially operating. He has just recently completed the first section of his new Lakeside station, embracing 40,000 kilowatts capacity, and which will ultimately be 200,000 kilowatts. This first section has eight 1300 horse-power Edge Moor boilers. We have just completed some operating tests in which we believe the highest efficiencies that have ever been obtained were secured. These tests were run under the direction of the Bureau of Mines in co-operation with Mr. Kreisinger, and I am enclosing herewith a brief summary of the results. You will find in the paper presented before the American Iron and Steel Institute a very interesting series of tests.

We are very earnest believers in the future of powdered coal, not only in this country but in all the countries of the world. We are not so much concerned in making quick or indiscriminate installations as we are in seeing that the installations made by this company are, in the first place, justified, and, in the second place, are put in on a correct engineering basis. Much of the present uncertainty in the minds of engineers as to the true value of this method of burning coal has been caused by the careless and slipshod work done by those who have been promoting its use, and by the recommending of installations for places where they could not be properly justified.

We believe that powdered coal presents very excellent opportunity for industrial development in countries such as Italy, France and China, where low-grade fuels are available, but not practicable under present methods of combustion. One of the most successful installations we made was on the Central Railway of Brazil, where we equipped thirteen locomotives to burn the native coals. These coals range up to about 30 per cent. ash and 9 per cent. sulphur. These locomotives have been in operation over four years, and that their operation has been successful is evidenced by the fact that the Brazilian Government is now negotiating for additional equipment. The Brazilian Government, we understand, spent some 2,000,000 dols. upon investigations to devise some correct method of using this native coal, but its use was never successfully accomplished until used in pulverised form.

Data covering four tests, boiler No. 8, at the Lakeside station of the Milwaukee Electric Railway and Light Company, taken from report of John Blizard and Henry Kreisinger, read before the A.S.M.E. at Chicago.

Test No.	1	2	3	5
Duration, hours	44	24	20	24.5
Rating of boiler equipped, per cent.	138	214	208	137
Efficiency of boiler alone, per cent.	83.4	82.3	82.3	85.6
Efficiency of boiler and economiser, per cent.	86.3	87.3	86.8	90.2
Calorific value of coal, B.T.U.	12,306	12,024	11,920	11,485
Gas analyses—				
CO_2 second pass	16.1	14.9	15.3	16.6
CO_2 leaving boiler	15.8	14.6	14.7	16.0
CO_2 entering economiser	—	12.6	12.6	14.3
CO_2 leaving economiser	10.4	11.9	12.0	13.2
Gas temperatures—				
Leaving boiler	436	484	470	432
Entering economiser	394	408	426	392
Leaving economiser	166	195	213	205
Feed water temperature—				
Entering boiler	168	192	187	176
Entering economiser	126	129	124	125
Steam temperature—				
Saturated steam	410	411	410	410
Superheated steam	548	592	598	528
Draught—				
Furnace	.015	0.19	0.17	0.04
Leaving boiler	.31	1.11	1.13	0.38
Entering economiser	.42	1.22	1.22	0.40
Leaving economiser	.51	1.65	1.67	0.52
Temperature of air entering furnace	—	—	—	107

COMBUSTION ENGINEERING CORPORATION,
PULVERISED FUEL EQUIPMENT DEPARTMENT,
H. D. SAVAGE.

New York, June 16th.

APPLICATION OF THE UNIFLOW ENGINE TO STEAMSHIPS.

SIR,—Seeing in one of your contemporaries that there is some hope of using means of promoting the economy of marine engines, such as CO_2 recorders, and other shore apparatus, as well as by paying more attention to the best size of engine to make the intended speed of ships, I am led to bring to the attention of your readers certain means of economy that are neglected by steamship companies.

The most attractive thing now is, of course, the oil engine, having as its object fuel economy and more cargo space. This in itself is good as far as it goes, but with it electric winches and other auxiliaries must be used, so that with the high cost of the main engine and these appendages the fixed charges may cause the total costs of operation to exceed those of the steam equipment.

There has been no improvement in marine engines for many years, as far as I can see. The triple-expansion engine having three or more cylinders, and provided with piston and slide valves, continues to be used. These valves give large clearances and must leak very seriously, and it is time that they were abandoned. One of the Dutch lines is building engines for their new boats with separate piston valves for top and bottom inlet ports, and separate Corliss valves for top and bottom exhaust ports. This is a step forward.

The uniflow engine presents, I believe, the only means of combating the oil engine by the adherents of the steam engine. The balanced opposed piston oil engine is one more approach to the displacement of the steam engine, and I expect to see wonderful results from the Doxford engine of that type, which mechanically is the most satisfying of anything that has been brought out or is likely to be.

By means of the uniflow engine as great economy can be realised in one cylinder as can be produced by the multiple expansion engine. In the length of a three-crank triple-expansion engine four uniflow cylinders and four cranks can be placed. Such an engine would be well balanced, and all cylinders with their valve gears would be exact duplicates. Consider what the significance of this is from a production standpoint. The cylinders and pistons of such an engine can be made of the customary length by the adoption of a central exhaust valve, and by its use the steam in exhausting does not sweep either over the heads or piston. Thus the short piston uniflow engine realises more perfectly than the ordinary uniflow the important thermal action of the type.

In order to obtain the best results, the inlet valves should be of the double-beat poppet type, which always remain tight if once made so, and produce reasonable clearance volumes. These valves should be operated by reciprocating cams actuated by any of the well-known reversing gears, always avoiding toothed gears. The central exhaust valve should be, I think, a Corliss valve, as it works in best, and as it needs no reversing mechanism it can be operated by a lever from the crosshead. This valve, on being made tight, will remain so and will work easily, because it will be in contact only with low-pressure steam, and steam which has lost its superheat if superheated steam is used.

What can be more satisfactory to contemplate than a balanced four-cylinder four-crank engine, with its cylinders, which will be small, and valve gears duplicates, with no reversing exhaust gear, with a steam pipe along one side branching to the four cylinders, and an exhaust pipe on the other side with four branches receiving steam from the cylinders? A 3000 horse-power engine would have four 40in. cylinders, or thereabout.

The uniflow principle can be further utilised by making the auxiliary engines on the same principle, even to the feed pumps, winch and steering engines. Ordinary steam pumps are steam wasters, because they condense so much steam in the cylinders, and it may be a question whether, in view of this and losses from radiation and leaks, it would not be better to work them from the main engine, and heat the feed with live steam instead of using the exhaust from the auxiliaries for this purpose. If the exhaust did not contain so much water, which only contains sensible heat, this question would, of course, not permit of argument. Now, by making the steam-driven auxiliaries of the uniflow type, the cylinder condensation would be reduced and exhausting into the feed-water heater would utilise a larger proportion of the latent heat of the steam.

The proper M.E.P. to be used will be a question of argument, but I believe that as low as 25 lb. will be justifiable, especially as uniflow engines will be used as means of economy. Slightly larger cylinders should not stand in the way of this economy.

In regard to boilers, while the Scotch boiler is heavy and expensive, it is more economical than the water-tube type, maintains its economy in service better, and permits more perfect cleaning of the tubes. Tests show that better gas analyses can be obtained from the Scotch boiler. This is because the air that purposely is admitted mingles with the gases better and is not over-supplied and the boiler cooled off by in-leaking air, as is the case with water-tube boilers, and the latter phenomenon cannot be prevented, and grows worse with time. The gases from Scotch boilers escape at higher temperatures than from water-tube boilers because there is no air leakage to cool them, and this makes superheating and air heating by escaping gases more effective than in water-tube boilers. Moreover, Scotch boilers are free from the everlasting nuisance of brickwork, except in the bridge walls, and even this can be eliminated by the use of cast iron bridge walls.

Boston, Massachusetts. F. W. DEAN.

USES OF STAINLESS STEEL.

SIR,—With reference to a paragraph in Dr. W. H. Hatfield's letter in your issue of June 24th, contesting the common impression that stainless cutlery does not retain its edge as long as ordinary knives, it is undoubtedly the fact that it does not. His appeal to experimental work in this direction is beside the point, because it is not a question of composition of steel at all. A knife merely washed would gradually get blunt of whatever steel it were made; but a knife cleaned with emery powder on a knifeboard would remain sharp even if it were made of wrought iron, and this is true in a lesser degree of a knife cleaned in a machine. Makers of stainless knives must instruct the public that the blunting is not due to any inferiority of the steel, but to the absence of knife powder, and that occasional sharpening will be necessary. E. CHAPPELL.

Portsmouth, June 27th.

WAGES IN GERMANY.

SIR,—Your paragraph on "Engineering Wages in Germany," page 665 of your issue of June 24th, does not seem to me to be a fair representation of the facts. Surely the basis of comparison should be the purchasing power in the country in which the wages are earned, and on that basis the wages you quote as being paid to fitters, turners, mechanics and tool makers in Germany, viz., six marks per hour, are very little, if any, below the wages paid here. It is the incidence of exchange which gives Germany the pull over England, and not Teutonic "hard work, thrift, or economy," to which the "review of the situation issued by a well-known city house" attributes Germany's industrial strength.

London, June 27th. O. J. F. THORPE.

Railway Matters.

THE Permanent Way Institution, under the presidency of Mr. John Miller, chief civil engineer, Great Eastern Railway, has just held a very successful summer meeting in Belgium.

THE Indian Railway Conference Association has resolved to recommend to the Government of India that the automatic continuous vacuum brake should be brought into full operation on all trains of the broad-gauge railways as from April 1st, 1922.

THE Railway Rates Advisory Committee's report on coastwise shipping has been published—Cmd. 1372—but no change in the companion rates by railway is recommended. The true remedy is said to lie in a reduction of the cost of carriage by sea and particularly in the terminal charges.

THE appeal of Mr. Clapp, the Chief Railway Commissioner of Victoria, to the traders, mentioned in this column on May 20th, has now been followed by the announcement that by better loading per truck—one of the items appealed for—2500 additional trucks have been made available.

THE Metropolitan District Railway has installed an electric bell at some stations for starting the trains. A wire is suspended above the platform edge which the guard can pull down without leaving his compartment. The motorman starts on hearing the bell. No whistle is blown or green flag waved. The wire is out of the reach of anyone on the platform.

THE Irish railways have come into line with the British as to claims against the Government for arrears of maintenance, use of stores, &c. They are to be paid a sum of three millions. The amount is proportionately less than the sixty millions to be paid to the British railways, firstly, because their control did not begin until January 1st, 1917, and, secondly, because there has been less abnormal traffic.

THE reference in Colonel Pringle's report on the Abermule accident to tablet exchanging apparatus reminds us that this was invented in the late 'eighties by Mr. James Manson, when he was locomotive superintendent of the Great North of Scotland and before he went to the Glasgow and South-Western. It picks up and deposits the tablet by an apparatus on the engine and on the line. Mr. Manson never patented the idea.

FIVE weeks hence the control of the railways expires, but the proceedings in Committee on the Railways Bill have got little further than Part I. It is now proposed to divide the Bill so that Part III., dealing with the establishment of a Rates Tribunal, shall go to a separate standing committee. The Labour Party is anxious about Part IV., which refers to wages and conditions of service, but we think there need be no anxiety as to this, as the companies and men have come to terms. As on some points they went against the wishes of the Minister, it is not likely that the companies will assist in any delaying tactics.

THERE are indications that even when the railways are grouped there will still be competition. During the restricted services of recent years Shrewsbury and the Cambrian Railway have been served from London by the Great Western only, which company has, moreover, conveyed the through coaches to Llandrindod Wells, although it is on the London and North-Western system. Now, not only are these through coaches restored to the North-Western, but the latter company has a through service between London and Shrewsbury, the Cambrian Railway and Aberystwyth. The last named is an entirely new service.

DURING the last two years many passengers and railway servants have been killed and wounded as a result of the civil disturbances in Ireland and trains have been derailed. As far as we can remember, no one has hitherto been killed as a result of any railway accident maliciously caused. At Adavoyle on the main line of the Great Northern (of Ireland) on Friday, the 24th ult., however, a troop train proceeding from Belfast to Dublin, was derailed and five soldiers and the guard were killed. Following the precedent of the Quintinshill accident, the soldiers are regarded as passengers, and this mishap, therefore, makes the third fatal passenger train accident this year.

THE many friends of Mr. W. Willox, the chief civil engineer of the Metropolitan Railway for the last fifteen years, will be interested to hear that he has resigned that position, as on the 30th ultimo, to start in private practice. Few people are aware what a pioneer the Metropolitan has been since it was opened nearly sixty years ago, and in this direction, during Mr. Willox's chief engineership, it has adopted the Sandberg high-silicon steel rails, movable angles at crossings, manganese steel points and crossings, reinforced concrete buildings and bridges, all-electric power signalling, automatic signalling—the first in this country to use the upper quadrant movement and position light signals—audible warning for platelayers working in tunnels, &c. Mr. E. A. Wilson, a divisional engineer of the Great Eastern Railway, succeeds Mr. Willox on the Metropolitan Railway, Mr. Willox being retained as consulting engineer to the company.

THERE are two interesting features about the train alterations that are being made this month. When the big reduction in train services was made in December, 1916, the London and North-Western and Caledonian Companies ceased to convey passengers between London and Edinburgh; that traffic was left to the East Coast companies. In the spring of this year the Caledonian Company gave notice that it was going to withdraw this embargo from the passenger allocation scheme, and now, once more, passengers may journey between London and Edinburgh by the West Coast. The restraint was bound to have a bad influence on the latter route. The other interesting point relates to the restoration of the Midland trains between London and Halifax and Huddersfield. Through coaches were run which were worked from Sheffield to Thornhill on a Lancashire and Yorkshire train between Sheffield and Bradford, Exchange, Station. The connection to and from Bradford was not, however, advertised. Under the restored services there are to be through carriages between London and Halifax, Huddersfield, and Bradford, Exchange.

Notes and Memoranda.

A DESCRIPTION of a very thin plate storage battery, having about three times the exposed surface per pound of material compared with any other commercial battery, was given at a recent meeting of the American Electrochemical Society. The electrical output per unit weight of lead and active material is 50 to 200 per cent. higher than that of the standard batteries, and the plates are less subject to mechanical defects and variability.

PRESIDING at the summer meeting of the Institute of Heating and Ventilating Engineers at Sheffield, Mr. Frank Biggin said Sheffield could be lighted and warmed from the exhaust steam and waste gases now blown into the atmosphere which made Sheffield notorious. Glaring instances of waste were to be found in great manufacturing concerns. Every effort should be made to economise in these days of high costs. A special committee had been appointed to consider district heating.

SOME recommendations for the safe handling of radium are given in the *Chemical Trade Journal* as follows:—It should always be handled with forceps and not with the fingers. It should be carried from place to place in long-handled boxes lined on all sides with 1 cm. of lead. Manipulations should be as rapid as possible. Radium should be stored in an enclosure the wall thickness of which should be equivalent to not less than 8 cm. of lead. In preparing radium emanations, rubber gloves should be worn, and care taken against the escape of the emanations. The room ought to have an exhaust electric fan.

IT is reported that tests carried out by the Swedish Ore Commission at the Mertainen orefields show that the ore obtainable from that source is very rich, averaging as it does from 65.5 to 68.5 per cent. of iron and only 0.006 to 0.008 per cent. of phosphorus. The fields, which are State-owned and are situated right in the north of Sweden not very far from the Norwegian and Finnish borders, are estimated to contain 36 to 40 million tons. Plans for a special railway to Kiruna and for building rolling mills capable of an annual production of 100,000 tons of finished rolled material have been drawn up and are now being investigated.

IN a paper on "Mechanical Transport" read before the Institute of Municipal and County Engineers, Mr. A. R. Galbraith states that with electric vehicles there is neither smoke nor smell, and but little noise; they are easy to manipulate; and the cost of maintenance and repairs is low compared to that of petrol vehicles. They are, however, more costly to purchase than those of other kinds of mechanically propelled vehicles, and have disabilities in connection with climbing steep gradients. In Sheffield, where these vehicles are extensively used, the city is very hilly, and their vehicles have been restricted to a 2-ton capacity in consequence, although with that load they will go up any hill in Sheffield.

SWITZERLAND is now using her utmost endeavour to develop her immense resources in water power, which are officially estimated to contain a capacity of four million horse-power. At the beginning of 1921 a total of 171 works—of over 500 horse-power—had been erected or were in process of erection, whilst 190 works—of over 1000 horse-power—had received, or had applied for, the necessary authorisation for construction. Among the power stations already built, or building, are five with from 60,000 to 68,000 horse-power; one of 52,000; one of 48,600; three of 45,000; one of 42,000; one of 40,800; and ten of from 20,000 to 32,600; among the projected stations are fifteen of from 60,000 to 200,000, and eleven more of 50,000 to 55,000.

THE organisation possessed by trades unions could effect, according to Sir Kenneth Goadby, the most far-reaching inquiries into the actual health of its members, to a degree that no other organisation can possibly equal. The health committees already established in certain industries and factories have done some good, but, unfortunately, are not always encouraged by the trades unions. Where Whitley Councils have been established they have undoubtedly been of considerable advantage, both to the workers and to the employers, because they tend at once, by a closer intercommunication one with the other, to eliminate from the worker the feeling that the employer has no interest nor concern in the health of the employees, and the employer finds the workmen ready and willing to co-operate with him in methods for their mutual benefit.

FOR the correction of power factor on small loads, and where an attendant is not available, the American General Electric Company has standardised condensers ranging from 40 to 125 cycles, and for voltage of from 220 to 2300, and in capacities from 30 to 300 kilovolt ampères. For circuits of over 2300 volts, the voltage is transformed down to 2300 volts, whilst for voltages of 220 to 550, an auto-transformer is provided to transform the voltage up to 1200 volts in order to make more economical use of the active material. The equipment consists of a number of units each of a capacity of 5 kilovolt ampères at 60 cycles. These units are connected in parallel across each phase, and arranged so that they can be cut in or out as required in order to vary the capacity of the condenser with changes in the load when the full capacity is not required.

IN a paper read recently before the American Institute of Electrical Engineers, P. Torchio put in a plea for higher temperature limits in low-tension paper-insulated cables. He emphasised the point that while in machinery a 105 deg. allowable limit is reached for long periods, low-tension cables, as commonly used in large distribution systems, are not subjected to the maximum temperature except for short periods of time each day, so that, in such cases, such a limit is much safer than for machinery. The author considers that the limiting temperature should be a function of the load factor, so that if the apparatus, either cable or machinery, is to operate for long hours at full load, the limiting temperature should not exceed, say, 90 deg. Cent., while, on the other hand, if the cable or machinery is to operate for a short time at heavy load and then be subject to a long period of cooling, the limiting temperature for the peak loads should be raised and the 105 deg. limit should be standardised.

Miscellanea.

THE blast-furnace and two Cowper stoves of the Newcastle Iron and Steel Company, South Africa, have been completed, and it is expected that smelting will be started in one or two months.

COAL has been discovered about 30 miles east of Pretoria, South Africa, and arrangements are already being made for its delivery in the town. Several pits, 120ft. deep, have shown that the seam is 13ft. thick.

THE offer of Mr. E. M. Hughman, of Bombay, to give a donation of £250 to the Benevolent Fund of the Institution of Electrical Engineers on condition that nineteen similar amounts were contributed by June 30th has been extended by him to December 31st, 1921.

IT has been decided to postpone the Co-partnership Exhibition and Congress, which was to have been held at the Crystal Palace in September, till next year. A luncheon, at which Lord Burnham will preside, will be given by the Labour Co-partnership Association on July 20th.

THE Chinese Government has given permission to the Chihli Construction Corporation to proceed with the building of a port at Taingho, near Tientsin. A power station will be put up at Tangshan, or some other coal-producing centre, to supply the new harbour with power.

THE Ministry of Agriculture and Commerce of China has sanctioned the establishment in Peking of a museum for the exhibition of China's minerals. The Chief of the Geological Survey of China, Ting Wen-kiang, is the leading spirit in the movement, and the cost will be defrayed by the mining companies throughout the country. The museum has already been inaugurated, and contains a valuable and instructive collection of China's minerals.

AN arrangement has been entered into between the Rose Deep and Simmer and Jack Proprietary Mines, Limited, Transvaal, for the installation of a joint central pumping plant at the latter company's Rhodes shaft for dealing with both companies' mine water. This joint pumping plant will have a sufficient capacity to handle the water made in the Simmer and Jack, the Rose Deep and in the adjacent closed-down mines, together with that made in the Knight Central, Limited.

IT is reported officially from Johore that an iron mine has been opened in the district of Batu Pahat, and that 5000 tons of ore are being turned out per month. The ore is shipped to Japan; but as there are signs of coal in the same district, there are hopes that the ore may be smelted eventually on the spot. However, it is not too certain, if coal is found, that it will be usable for smelting purposes. Upwards of 200,000 tons of coal were mined in Selangor, one of the Federated Malay States, last year.

IN the course of a report to his Government, Mr. W. J. Page, United States Trade Commissioner in London, says: "In these days of trade depression, it comes as a surprise to note the strides which the British machine tool industry is making in its export market. The statistics for the first quarter of the present year indicate that Britain has not only regained all lost ground in the production and export of heavy machines, but is also extending its trade in the finer machines, which are of much higher value per ton."

THE Georgian Soviet Government published on May 28th a decree stating that all foreign-owned goods in Georgia which had not been sold within a period of fifteen days would be taken over by the Government and the owners credited with the value which would eventually be paid in foreign currency or goods. This measure will enable the Government to acquire possession of considerable stocks of foreign goods which foreign traders were compelled to leave behind when the British force evacuated Batoum and which have thus far been covered by "deeds of protection" issued by the Georgian Government. Much of this merchandise is British owned.

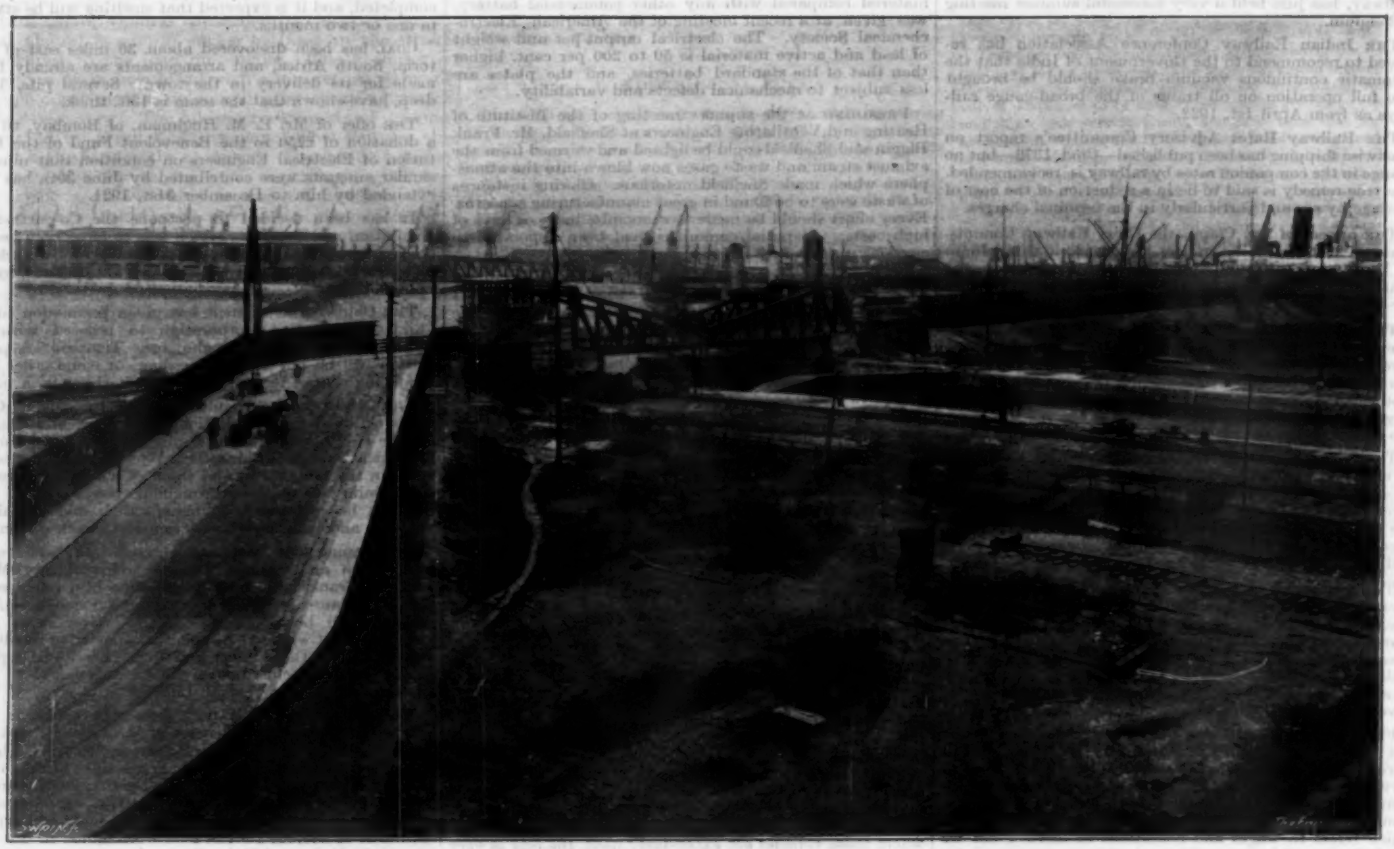
THE United States Federal Reserve Board, in its monthly statement for June, finds the outlook as regards the autumn trade reasonably encouraging, but says that conflicting tendencies are still discernible. In some branches of the domestic trade there have been recessions which are merely incidental to the abatement of spring activity. In other trades, however, the readjustment towards normal conditions has not been completed, as, for instance, in the iron and steel trades, in which it is generally believed further readjustments, both of wages and prices, are likely to occur. Agricultural conditions are stated to be good and many food products are cheaper.

A CONCESSION for the exploitation of considerable deposits of oil sands and bituminous and carbonaceous shales intercalated with sand deposits in the Canton of Geneva has been taken over by an Anglo-Swiss undertaking. The area of this concession covers a surface of approximately 12,000 acres, and it is being worked principally for the extraction of oil from bituminous sandstone. This stone contains up to 20 gallons of oil to the ton from the surface, and as the works proceed in depth it is expected that the yield will be much greater. A plant is to be erected capable of treating 200 tons of this sandstone per day. It is confidently asserted that petrol will be found, and borings have already commenced with this object in view.

CONSIDERABLE progress has been made by the Marconi Company in its preparations for carrying out important experiments in wireless telephony between Birmingham and London. According to a contemporary, a powerfully equipped station is now in course of erection at Frankley Beeches, a few miles from Northfield, and there messages will be received and despatched by the most up-to-date apparatus. Although work did not begin until May 2nd, in about six weeks two of the three huge "masts" were completed, and the third would have been finished before this time had there not been a little delay in the receipt of the requisite sections. Each "mast" is 100ft. high, the three being built at the respective corners of an isosceles triangle. The position is a commanding one, for the hill is about 800ft. above sea level, so that the total elevation of the aerials will be 900ft., and it is understood the new station will work in conjunction with the existing one at Hendon.

NEW ROYAL ALBERT DOCK EXTENSION

(*For description see page 29*)



BASCULE BRIDGE CARRYING DIVERTED WOOLWICH MANOR WAY OVER LOCK ENTRANCE

END VIEW OF DOUBLE BASCULE BRIDGE

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TWO-PAGE SUPPLEMENT.—PORT OF LONDON: ROYAL ALBERT DOCK EXTENSION.

THE ENGINEER.

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Low Power Factor.

AT a time when, owing to high prices, it is essential to get the utmost out of electric generating plant and mains, the power factor problem is of vital importance. Though in many ways induction motors are excellent machines, they possess the well-known disadvantage of drawing a wattless current for which the consumer does not pay, but which loads up the alternator windings and mains in exactly the same manner as the current which actually does the work. When, therefore, a large number of these motors has been connected to a system, the station engineer frequently finds, and especially if the motors are run underloaded, that the plant cannot work at its full capacity. According to the ammeters on the station switchboard the generators are fully loaded, but as some of the current is wattless the turbines are not drawing anything like their full amount of steam. Ever since the induction motor came into existence the problem of finding a way of getting rid of the wattless current or of making someone pay for the trouble which it involves has been before power station engineers. Obviously, if a plant cannot be worked at its full capacity it cannot earn the proper revenue, and in these days, when the price of new machinery and cables is at an unprecedented level, the matter is a very serious one.

Mr. Reginald Otto Kapp shows in his short paper read before the Engineering Conference last week that if the cost of the electrical part of a supply system is £15 per kilovolt-ampere of maximum demand, which he maintains is a moderate figure, it becomes £18.8 per kilowatt at a power factor of .8. The bad power factor, therefore, necessitates an additional expenditure of £3.8 per kilowatt. There are, of course, other more or less serious drawbacks which have been dealt with from time to time by engineers who are associated with alternating current systems. There does not, however, appear to be anything like universal agreement in respect to the manner in which the problem should be attacked. The scheme which Mr. Kapp advocates, and which in the past has been suggested by other engineers, is to make consumers install apparatus which will bring about the desired result. It is considered that by devising a special tariff which will make the consumer pay more for his current if the power factor is bad, it will be possible to get correcting devices used; but, as we have pointed out on previous occasions, it is doubtful if this is the best policy to pursue. One of the great difficulties is, of course, to succeed in getting consumers to understand the meaning of power factor and to appreciate why they should be called upon to correct a fault for which they are not directly respon sible. The power factor trouble naturally originates from the fact that, from the point of view of supply undertakings, the induction motor is imperfect. Manufacturers who decide to electrify works which happen to be in localities where only alternating current is available are supplied with induction motors as a matter of course. After a time, however, the central station engineer finds that, on account of a large number of these motors being connected to his mains, he cannot make his plant develop its full output, and he sets to work to find the most troublesome consumers, who are told, in effect, that unless they put in power factor correcting apparatus, which incidentally may cost them a very fair sum of money, they will have to pay more for their current. We do not maintain that the system is entirely wrong. What we do contend is—and we have found many central station engineers in agreement with us—is that the task of getting consumers to assist in the matter is often very far from easy. The power factor question does not trouble the user of direct current, and it ought not to affect the alternating-current consumer; although, of course, as long as induction motors remain in use, the problem will have to be faced. Though electric motive power is already used on an extensive scale, its employment will undoubtedly extend enormously in the future, and if plant and mains are to be used to the best advantage some satisfactory method of overcoming the difficulty will have to be found. There are, of course, various ways of reducing wattless currents. Leading electromotive forces can be injected into the rotors of induction motors, static condensers can be connected to the system, and over-excited synchronous motors can be employed. If consumers can be induced to use phase advancers or other correcting devices all well and good. It should be remembered, however, that induction motors are not the only alternating-current motors on the market. Within recent years self-starting synchronous motors have been greatly improved, and there seems to be no reason why they should not in many cases be utilised instead of induction motors, which necessarily draw their magnetising current from the mains. Where a fairly large motor is required and where speed regulation is unnecessary, it certainly seems that this type of machine often has much to recommend it. It appears, in fact, that as these machines, when over-excited, will draw a leading current and so compensate for lagging current on another part of the system, it might in certain cases be profitable to the power station engineer to offer inducement to consumers to use these motors instead of ordinary induction machines.

We find ourselves in entire agreement with Mr. Ll. B. Atkinson, who, in the course of the discussion on Mr. Kapp's paper, pointed out that it is better to get to the cause of the trouble than to apply a remedy. Of course, in the case of existing induction motor installations which are causing trouble at the present time the power factor will have to be raised by the use of special devices; but in view of the ever-growing demand for electric motive power and the importance of utilising generating plant to the best advantage, the question arises as to whether the use of ordinary induction motors ought not to be restricted. It should not be forgotten that besides self-starting synchronous motors, there are also commutator alternating-current motors, which are made in relatively small sizes and which do not affect the power factor to anything like the same extent as the machines now in common use. Apart from its bad effect upon the power factor, the induction motor, in its usual form, is not at all suitable when it is desired to vary the speed, and here again the commutator motor, though probably more expensive, is superior. We do not suggest that the induction motor should be completely abolished, but merely contend that as the power factor problem is at the present time troublesome and is likely to become even more so in the future, the possibility of employing other motors in certain cases should not be overlooked.

Elastic Limit and Yield-point.

IN a note presented to the Engineering Conference last week Professor Dalby dealt with the definition of that very important term the "elastic limit." That there is need for some accurate and generally accepted definition of such a term is obvious if only because at the present time it is used very loosely and in a manner which is often misleading, particularly when "elastic limit" and "yield point" are treated as if they were more or less synonymous expressions. Now, the yield point in iron and mild steel is a thing with which every engineer is familiar and to which he has for years learnt to pin his faith. There was, of course, ample justification for so doing while the materials mainly employed were wrought iron and mild steel; so long as working stresses did not too nearly approach the yield point there seemed to be little danger of failure; and, on the other hand, it was a point which could be determined with great ease in routine works testing by the "drop of the

beam" of the testing machine. But since those days—one is almost inclined to call them "happy days"—times have changed. In the first place, a much wider range of materials is now furnished to the engineer and utilised by him, and many of these metals—both alloy steels and non-ferrous alloys—do not possess the typical and easily determined yield point with which mild steel has rendered us so familiar. When we come to test such materials or to draw up specifications for them we are at once faced with a serious difficulty.

There is, however, another point of view which raises the whole problem to another plane. It is the recognition of the fact—derived mainly from many series of experiments on fatigue failure—that it is not, even in mild steel, the "yield point" which is of fundamental importance, but rather the truly "elastic" range of the material, and that this truly elastic range never extends to the yield point and sometimes lies very far indeed below it. Here we are faced, not merely with the practical difficulty of making a delicate measurement, but also with the greater task of endeavouring to understand "the inner meaning of things." There can be no doubt that at the present moment the whole question of fatigue and fatigue testing is in the melting pot, and that new ideas and probably new theories must arise to clear up the existing confusion. Still, the fact remains that there is, in most materials, a "true" elastic range within which neither steadily applied nor alternating stresses can cause any deterioration or fracture, and it is obviously the business of the testing engineer to devise some simple and easy method by which this range can be determined. Such a test would replace many of those which are at present contending for supremacy, often without much sound reason on either side. Fortunately, there seems to be some hope that such a really quick, simple, and practical fatigue test may become available in the very near future. While it would undoubtedly remove the most serious difficulties, the tensile test may yet be expected to retain its position, and for that reason a clearer understanding of the terms and measurements required in connection with it remains important. If we were to accept the definition suggested, rather than stated, by Professor Dalby, we should interpret "elastic limit" as being simply the "limit of proportionality" up to which a given material obeys Hooke's law of proportionality of strain to stress within the limits of accuracy of the means employed for measuring small strains. Yet, as Professor Dalby admitted, it is quite probable that Hooke's law of proportionality is never entirely obeyed, provided that the means of measurement employed are sufficiently delicate. On the other hand, it is perhaps better to define the limit of "elasticity" as the limiting stress which fails to produce permanent extension in the material—a limit which might well be termed the "limit of restitution." Extensions applied within this limit would do no irreversible work—or only an extremely minute amount of work—on the material, and might, no doubt, be repeated indefinitely without damage. Unfortunately, this particular limit is very difficult to determine in practice, and is therefore, under existing conditions, unsuited for practical routine testing. Ultimately it will probably be best determined by the methods of fatigue testing which we have mentioned above; meanwhile must we be content with the specification and determination of a "yield point" which, in many materials, has no real existence? This "determination" is made, as is well known, in many cases by the use of a pair of dividers, with which an observer tests the distance between two marks made on the test piece at a definite initial distance apart. This measurement is often made while the load is being rapidly applied, and by the time the observer has satisfied himself that extension has taken place and has signalled to that effect, the load has been carried to a point well beyond that at which the first signs of plastic extension could really be detected by this relatively crude method. Reliance upon such determinations is, therefore, unwise, and the specification of "yield point" in materials where there is no real marked sudden yielding is to be deprecated.

Fortunately, a fairly satisfactory alternative exists and has been incorporated in some of the recent specifications of the British Engineering Standards Association. It is the specification of a "proof load." There may be some doubt as to the appropriateness of this particular term, but the idea itself appears to be entirely sound. It is based upon the principle that, instead of endeavouring to ascertain in the course of a rapid tensile test at what particular stress permanent deformation occurs to a measurable extent, it is better to decide beforehand, as the result of accurate tests made by means of extensometers or otherwise, what stress satisfactory material of that particular type should be well able to bear without undergoing any extension more than a small specified amount, such as one-half per cent. If the figure thus arrived at is specified as the "proof load," it is a very simple matter to test any given specimen. All that need be done is to mark the test piece accurately with two fine lines whose distance apart is the standard specified gauge length; the specified "proof load" is then applied to it for a specified short time and the load is then removed and the test piece re-measured. If the lines marked on it have not moved apart by more than the specified amount—one-half per cent.—the test has been passed, and the breaking or ultimate stress, extension, &c., can then be determined by a further test on the same test piece. It is all very simple and quick; measuring appliances, such as small microscopes, can easily be mounted so that the measurement can be made in a few seconds without removing the test piece from the machine. Above all, however, is the great advantage that the manufacturer, the inspector, and the engineer all obtain a definite determination which bears some relation to the properties of the material, instead of a vague estimate of a non-existent yield point.

The Fuel Research Station.

During the past fortnight the fuel research station at East Greenwich has been thrown open, for the first time, for inspection by the members of the leading scientific associations and the technical Press. The general lay-out of the station and the principal plant erected there has already been described in official reports issued by the Fuel Research Board in 1918 and 1919. The site is about 250ft. wide by 900ft. long, and has been lent by the South Metropolitan Gas Company, by whose sidings it is fed. The first impression gained is that neither time nor money has been withheld in the endeavour to arrange all buildings and apparatus in a scientific manner, so that whatever the weather conditions, all investigations may be carried on without interference and in ideal circumstances. The average engineer accustomed to the management of the ordinary industrial works would, no doubt, describe the station as a laboratory on a huge scale, where processes are worked out in the customary manner of the analytical chemist and transferred to small-scale manufacturing plant. Unfortunately, there is not a great deal of sympathy between engineers and pure chemists, and the majority had come to look upon the East Greenwich establishment as the happy hunting ground of the academic mind where there was no room for the ideas of those who have to descend to the discussion of everyday working difficulties. This prevalent opinion is, however, by no means in accordance with the facts, for Sir George Beilby, the Director, has gathered round him an exceptionally capable and broad-minded staff, and one was struck with the workmanlike manner in which processes, such as carbonisation, are attacked.

In general, the station consists of two distinct but co-ordinated portions, namely, the chemical, physical, and photographic department, and the main building, where the various processes are carried out on a works scale. In the first-named, or analytical, department, a considerable amount of uncommon and costly apparatus is to be found. It is mainly in connection with the testing of gases, and one is struck by the fact that the everyday apparatus employed in industrial establishments is not considered sufficiently accurate for research purposes. For instance, instead of the favourite Orsat or Hempel gas-testing apparatus one finds the Bone and Wheeler arrangement and the Haldane apparatus. The last-named is utilised for the determination of the composition of spent producer gases, and is said to be correct to 0.02 per cent., whereas the Orsat apparatus will give a result within 0.2 per cent. only. The Bone and Wheeler method is employed for all gases containing a high proportion of combustibles, and is accurate to within 0.05 per cent. A feature of considerable interest is the British Oxygen Company's small liquid air plant, which is employed for the fractionation of low temperature coal gas into its various constituents.

Undoubtedly, the work being carried out at the station must mainly make an appeal to those interested in the carbonisation of coal and the gasification of other fuels. Low-temperature carbonisation, for instance, and the production of smokeless fuel have always been regarded with scepticism in this country. For this reason alone it is certainly instructive to find that Sir George Beilby has approached somewhere near perfection with his somewhat unique mild steel horizontal retorts, wherein briquetting is effected during the process of carbonisation and not afterwards. As is well known, the main defect of semi-coke is its friability, so that the introduction of a briquetting machine is nearly always called for. At East Greenwich, however, the disintegrated coal is placed in special moulding trays consisting of a number of cubical boxes. The trays are run into the retorts, carbonisation takes place at 600 deg. Cent., and when the trays are removed at the end of the distillation period, briquettes of smokeless fuel containing 10 per cent. of volatile matter and of a particularly tough nature are obtained. Perhaps greater things are to be expected from the Beilby mechanical rotating low-temperature plant, but it is not yet completed.

Although one gains the impression that there is a decided leaning at East Greenwich towards the low-temperature system, it must not be forgotten that a considerable amount of research is being carried out with the high-temperature process in vertical retorts. The Glover-West bench of four vertical retorts is unique in that it is fired by blue water gas obtained from a small Humphreys and Glasgow plant of the standard type. The main object in view is to determine the relative efficiencies of the process of steaming the coal charge with variable proportions of steam, and in this respect the work has been carried rather farther than that of the Gas Investigation Committee which is conducting its research at Uddingston. For instance, it has not as yet been considered altogether advisable to carry the steaming process beyond about 30 per cent. of the weight of coal dealt with, but at East Greenwich as much as 40 to 50 per cent. of steam has been admitted with decidedly instructive results. With 30 per cent. steaming a yield of some eight million British thermal units per ton of a fairly good coal may be usually expected; but it has been shown that with 40 per cent. of steam the yield is increased to nine million, and with 50 per cent. to ten million B.Th.U. Moreover, as steaming is progressively increased, so is the tar and ammonia yield enhanced, although the by-product coke obtained naturally undergoes reduction. Purely from the point of view of the thermal efficiency of the whole process it is difficult to say as yet where the economic steaming limit lies; but, from the standpoint of incombustibles, it would not seem advisable to go beyond 30 per cent. That different coals, however, demand entirely different treatment is shown by the variations between the research station results and those found at Uddingston.

So far as experiments with more or less unconventional fuels are concerned, mention must be made of the attempts to carbonise peat and seaweed in continuous vertical retorts. The first-named was found to give a good deal of trouble in the way of holding up in the charging shoots; but per ton of material dried to 20 per cent. it yielded 17,000 cubic feet of gas of 340 B.Th.U. calorific power with 5 per cent. steaming. The coke obtained was from 7 cwt. to 8 cwt., while the tar yield amounted to 17 gals. (water free). Air-dried seaweed is not exactly a substance which one would expect to be worth while carbonising, and it is still very questionable whether the process could ever become a commercial proposition. However, the problem was submitted to the Board, and interesting results have been secured. The gas yield is found to be about 1500 cubic feet per ton of the material dried to 30 per cent. moisture, the calorific power of the gas being 560 B.Th.U. per cubic foot. In addition, there is a yield of about 16 gals. of tar oil and 5 cwt. of charcoal forming the solid residue.

In addition to the research which is being carried out in connection with gaseous fuels, the Board is busily engaged on many other problems of less specialised interest, amongst which may be mentioned the experiments on boiler operation with pulverised coal, peat, &c., and the production of suitable liquid fuels for Diesel engines.

Literature.

Elements of the Mathematical Theory of Electricity and Magnetism. By Sir J. J. Thomson, Master of Trinity College, Cambridge. Fifth edition. Cambridge, at the University Press. 1921.

It is a double advantage to the reader when the elementary text-book is taken in hand by a master of exposition and at the same time a pioneer in the latest development of his subject. In this case we do not taste the *crambe repetita* of the cram treatise prepared by the scientific hack, and the flavour is fresh of the latest ideas, in a subject where the novelties of recent years have been startling. Maxwell's "Electricity and Magnetism" appeared nearly fifty years ago, and created a revolution in the outlook and treatment in adopting Faraday's point of view, where the electric stress in the medium of his lines and tubes of force was brought forward in explanation of the facts, in preference to the old theory of potential, and its constancy over a conducting surface, with a disappearance of electric stress in the interior. Formerly the conductor was looked upon as the seat of electrical energy, but this point is discarded in the modern view, where the electricity is supposed to reside anywhere but in the conductors, but must be sought in the di-electric interspace in the electric state of the Faraday lines of force. The ancient theory is still followed in starting the subject of the general principles of electrostatics by a discussion of potential, as in Chapter I here, and the properties of the equipotential surfaces of conducting bodies, separating them from the dielectric medium.

But Chapter II, on lines of force, introduces the reader to the properties of the electric field in terms

of Faraday tubes, and here the insight is gained into the modern physical point of view. The Faraday tubes are built up of lines of force, orthogonal to the equipotential surfaces, and we visualise them in space in our mind's eye.

Uniaxial symmetry is encountered as a rule in an electrical problem, and here the meridian sections of equipotential surface and Faraday tube of force can be drawn on a plane diagram, in a series of orthogonal curves, shown in many specimens in this Chapter II, of the potential function and the Faraday force function, as we may call it. The name force-function has been discarded in dynamics, on Professor Tait's suggestion, and so we may retrieve it here for another purpose. If these figures, such as 16, or 98, are turned to bring the line A, B joining the poles vertical, the stereographic projection of a hemisphere is seen, and a dynamical analogue can be stated better.

These diagrams of lines of force are more instructive than equipotential lines in showing to the eye the stress in the dielectric, the lines being most crowded where the stress in greatest; and in many cases the analytical expression of the Faraday force function is of simpler structure than the potential function, and it is good practice to be accustomed to think of the force function for preference.

Thus with respect to an axis of symmetry taken as O x, the potential function e/r of a point charge e, spread uniformly over a sphere, will be $2\pi e$ vers θ e times the spherical segment of the unit sphere, or the equivalent solid conical angle.

The force function of an insulated circular disc, or of a confocal oblate spheroid of which the disc is the focal plane, is given by the conjugate axis of the confocal hyperbola through the point, a simple algebraical function, whereas the potential function is transcendental.

So, too, in the equivalent electromagnetic question, Maxwell's M of the self-induction of two parallel coaxial circular currents is the force function of the magnetic potential Ω, due either to the electric current round the rim of the circle, or to the equivalent uniform normal magnetization of the circular plate; the electric and magnetic lines being shown thus linked together. But whereas Ω is the solid angle subtended by the circle at a point, and requires the third elliptic integral in all its complications, the force function M of mutual induction can be expressed by the complete elliptic integral, first and second.

The expansion of the uniaxial potential function in a series of zonal harmonics can be converted at once into the corresponding force function in the manner given first by Ferrers.

The solid angle Ω is of frequent occurrence in an electrical problem, and a familiar conception need not to be avoided in the elementary treatment here. The physical and mental picture is simple, as in looking up at the sky, and the elliptic functions required in a numerical case can be banished, and the value read off on a diagram such as Maxwell's XVIII; this should be re-calculated, enlarged, and the curves engraved as a nomogram for use in electrical work, in place of a numerical table of double entry.

There is no need for the novice to shirk a number of the most important problems, such as the potential of a circle or spherical segment, gravitation or of normal magnetization.

Half the difference of the Faraday force function between two lines of force on the uniaxial diagram will give the electric induction through the zone of revolution which they cut out on any equipotential, and so the electric charge on the zone.

Thus, when the force function is given, it solves by simple subtraction the questions in Chapter III on capacity and condensers, the capacity of a condenser being the ratio of charge to potential.

In this way the capacity of an open spherical bowl is shown to be the meridian girth of the bowl, measured by a tight thread; and this verifies for the complete sphere, or for the plane circular disc.

The specific inductive capacity of the interspace of the dielectric insulating medium introduces a modification analogous to that of magnetic induction, in refracting the lines of force in entering and leaving the interspace.

A change is made here usually from the electrostatic to the electromagnetic system of units, as explained in Chapter XII. This change is apt to be baffling to those not always engaged in the modern electrical applications, especially in retaining in the memory the artificial powers of 10 introduced when the practical units are employed, of the volt, ohm, ampère, farad.

Thus a statement in Silvanus Thompson's "Elementary Electricity" was hard enough to throw a whole British Association section into confusion: the statement of the capacity of a plate condenser in a formula, with no information of the units employed.

The chief difficulty was the identification of a numerical factor 11.22, but this was traced eventually as the equivalent of 4π and v^2, in the form $36\pi = 112.1976$; then came the task of attending to the powers of 10 required to convert the result into microfarads.

The formula is a typical challenge to throw down to cast gloom on the electrical assembly.

Electrical inversion in Chapter V is a powerful geometrical method, invented by Sir W. Thomson, for giving a picture of the physical state. The method of §. 84 of beginning with the electrical state of two equal and opposite point charges might be extended with advantage in an explanation of the method, by taking two point charges e and $-e'$, opposite but unequal, at Q and Q'. One equipotential surface is the sphere of zero potential, over which $\frac{e}{PQ} - \frac{e'}{PQ} = 0$; and bisecting the angle Q P Q' internally and externally will give the points A and A' on Q Q', ends of a diameter of the sphere, which can then be drawn; the force at P is then calculated, and the electrification when the charges at Q and Q' are screened from each other by this sphere, uninsulated, to earth. Thence all the other properties follow by simple geometry. Take, for example, the well-known properties of a spherical bowl, insulated and electrified, and invert with respect to a point Q on the rim, the results are obtained of the electrification induced in a semi-infinite plate by a point charge at Q.

An acquaintance is presumed with the elementary principles of the Calculus. Every French schoolboy acquires this under the guise of algebra, and is not frightened by looking at the subject too long, and as liking it less. But a Calculus dodger is encouraged to chance the subject, as formerly he chanced the Greek. These artful dodgers only end in giving themselves no end of extra trouble, and remain in the ranks of the feeble and unilluminated practicians of rule of thumb. Perry knew how to cure this feeble outlook in his unique eloquent style. He drew in a concrete illustration at every stage, taken from well-known operations seen around, and was fettered by no tiresome tradition of logical procedure and vigour. Beginning with an alternating electromotive force E cos $p\,t$, a differentiation with respect to t will multiply E by p, and give a lead of $\frac{1}{2}\pi$, a right angle, to the phase angle $p\,t$. And, conversely, an integration divides by p, and gives a lag of a right angle. Integration and differentiation carry on together hand in hand, Newton's direct and inverse Fluxions, treating integration as anti-differentiation, much as division in arithmetic is anti-multiplication.

On the old-fashioned plan, the Differential Calculus was inculcated for a year at least, before it was allowed to touch on Integration, keeping the two subjects in water-tight compartments. Perry would have gone farther, and reversed the order of the names, giving the Integral Calculus the precedence, in Integral and Differential Calculus, as older by two thousand years. It is easy to grasp the picture of an integral, as representing total growth, whereas rate of growth is not visible in the differential coefficient. We can see how a tree has grown in a few years, although we cannot see it growing.

The next bulkhead to the third branch of Differential Equations can be obliterated by a mere introduction of the name. The integration of x^3 would then appear as the solution of the differential equation $\frac{dy}{dx} = x^3$, and so on for the other functions. In this way the novice loses all terror of these appalling names, as Silvanus Thompson called them in his "A B C." It is economical in writing and printing to separate the operation of differentiation, as $\frac{d}{dt}$, from the function operated on, and to replace it by a single letter, as D, and then to utilise the resources of the Calculus of Operations, without mentioning, however, its terrible name. Thus, A and B representing constant quantities, the operation A D + B, applied to E cos $p\,t$, multiplies it by $\sqrt{(A\,p^2 + B^2)}$ and gives a lead $\tan^{-1}\frac{A\,p}{B}$. Conversely, the solution of the differential equation $(A\,D + B)\,x =$ E cos $p\,t$ is $x = \frac{E}{\sqrt{(A\,p^2 + B^2)}} \cos\left(p\,t - \tan^{-1}\frac{A\,p}{D}\right)$, so that amplitude E is divided by impedance $\sqrt{(A^2\,p^2 + B^2)}$, and phase $p\,t$ suffers a lag $\tan^{-1}\frac{A\,p}{B}$.

The differential equations of electromagnetic induction in Chapter XI can all be treated in this incisive manner, as Perry has explained, in defiance of the prudery of the rigorous mathematician, strewing the primrose path with his brickbats and broken glass. Although destitute of this ideal of rigour, the symbolical method of solution is a short cut to a correct solution, in dynamics as well as electromagnetism. Perry lost no opportunity of pointing out the dynamic analogue of an electromagnetic problem.

Before the construction of the gyrocompass, navigation was impossible without the magnetic compass. And it was useless to build an iron ship, as the sailor would refuse to put to sea in it till he had been persuaded by careful experience ashore that it was possible to screen the induced magnetism in the hull, or else allow for the disturbing effect by means of a formula. This was the experience of Thomas Love Peacock in 1830, when he was introducing steam communication with India. Before the introduction of the gyrocompass submarine navigation was impossible, and in the swift voyages on a direct course of a steamship across the Atlantic practically the only observation required in the navigation was of azimuth, to use in correcting the magnetic variation of the ship's course and place.

Magnetic induction, discussed in Chapter VIII, is thus of great practical importance, and the screening effect of a hollow iron shell—or cylinder—deserves careful study. The analysis is continued to the case of the solid ellipsoid; this can soon be extended to the case where the cavity is a confocal ellipsoid. But it is important to notice that Maxwell points out how the method cannot be extended to another shape, unless the gravitation potential of the body is a quadratic function in the interior; and so a further generalisation is arrested.

The great novelty in the book is found in the last three chapters, on the electromagnetic theory of light, thermo-electric currents, and the properties of moving electric charges. Here the author is on his own ground in describing his own pioneering experimental and theoretical work; and it is a great privilege to read them in his own language. We are here on the borderland of the science, looking over the frontier into those mysteries of general space attracting such great attention to-day; but the author is so kind as to stop short, and protect the young reader contemplated in his scope from these disturbing revolutionary theories.

We are grateful to the author for sparing us the distracting footnote habit. Perry was addicted to it, adding footnote on footnote, till the thread of the argument was lost. One little growl to finish, about the index. Although not an Irish index, requiring an index to point out whether the numbers refer to page or article, it would be a comfort to the reader to see repeated in every column a description of the reference number, whether to page or article; and there is no harm in adding both.

SHORT NOTICES.

Electrolytic Deposition and Hydrometallurgy of Zinc. By Oliver C. Ralston. London: The McGraw-Hill Book Company. 1921. Price 18s. net.—Ever since 1880, the author of this book states, serious attempts to commercialise hydrometallurgic processes for recovering zinc have been made, and the theories of leaching, purification and electrolysis have all been well worked out, but no one recognised the immense importance of purification of the solutions before electrolysis. This phase of the subject has needed exposition, and it is with this particularly in mind that the present book has been written. Some space in the early part of the book is devoted to the history of zinc hydrometallurgy, roasting zinc ores, sulphate solutions, leaching and purifying. There are also chapters on the electrolysis of zinc sulphate solutions, chlorinating ores and purifying solutions, the electrolysis of zinc chloride, electrolytic zinc refining, and examples of practice. The latter chapter gives particulars of some important plants in operation in the United States. Altogether the book should, we think, prove of considerable value to those interested in the subject.

The Empire Municipal Directory and Year Book, 1921–2. London: The Sanitary Publishing Company, Limited, 8, Breams-buildings, E.C. 4. Price 10s. 6d. net.—The lists contained in this year book, which is now in its thirty-ninth edition, are of especial value to any firm which does business with local authorities. Many articles of great interest are to be found in this present volume. Road construction and materials, engineering and building construction, lighting, sewerage and sewage disposal, all these are dealt with by people who are authorities on the subjects, whilst the most up-to-date information on municipal affairs is contained in it.

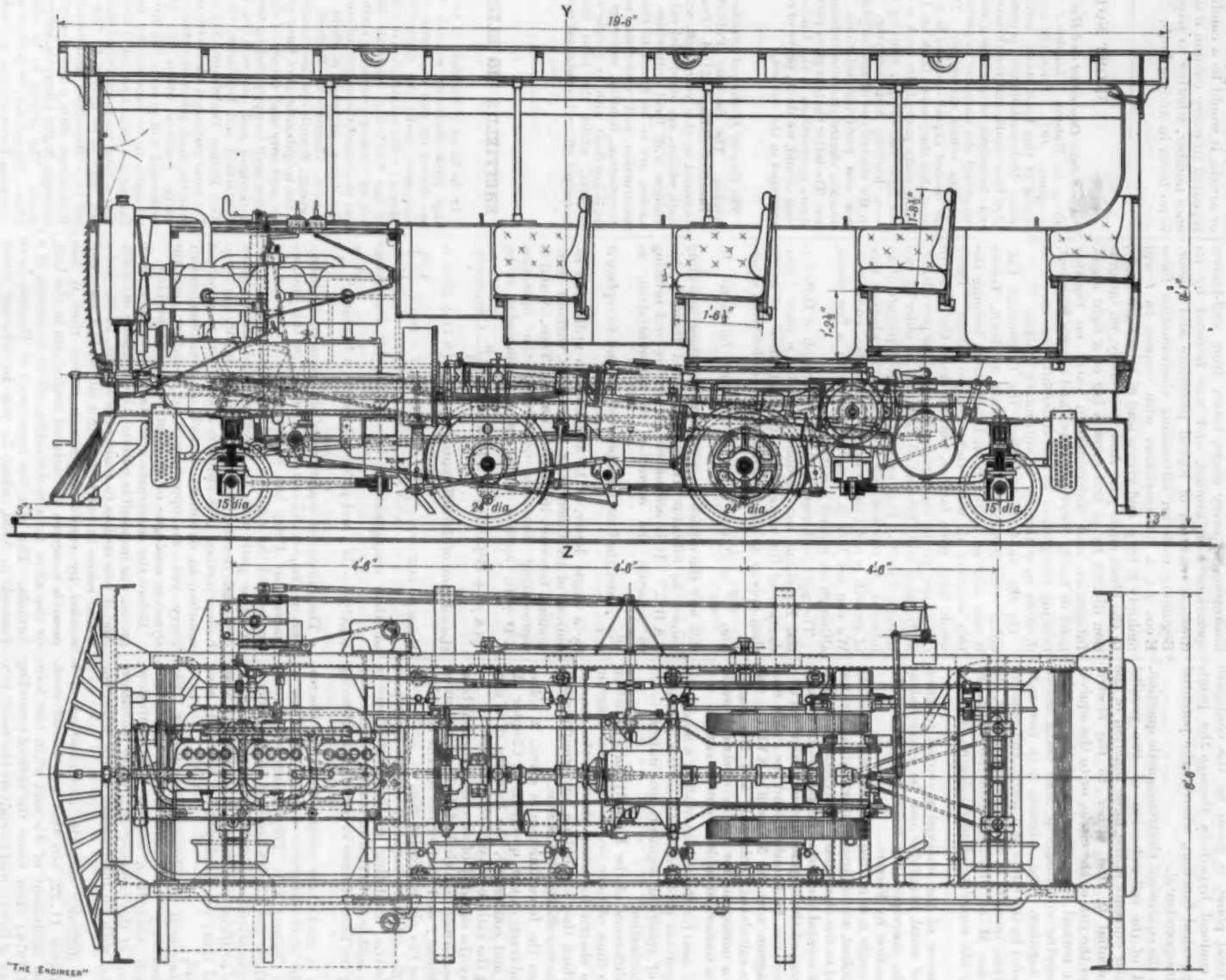
SHEFFIELD'S BIG ELECTRICITY SCHEME.

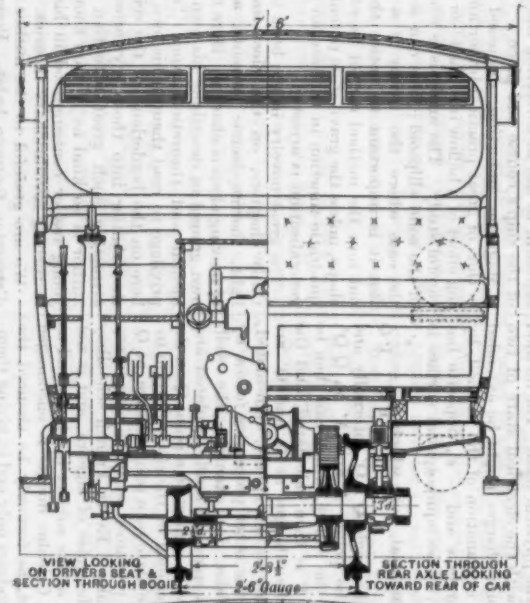
IT looks as if Sheffield is to become the centre of a huge joint electricity scheme, for the City Corporation has drawn up and deposited with the Electricity Commissioners, under the Electricity (Supply) Act, 1919, a scheme for the constitution of a Joint Electricity Authority for the North-East Midlands district, the object being to link up existing generating stations, to build new stations, and to control the supply of current throughout the area. The latter includes Sheffield, Rotherham, Doncaster, Buxton, Chesterfield, Retford, Worksop, Brigg, Gainsborough, Scunthorpe, and many urban and rural districts in the neighbourhood of those places. It is proposed that the authority shall consist of eighteen members, of whom twelve shall be appointed by the Councils of Sheffield and Rotherham and one each by the Borough Councils of Chesterfield and Doncaster, the County Councils of the West Riding, Derbyshire, Nottinghamshire, and Lindsey. The total maximum loads estimated for the first five years from the main generating stations amount to 227,000 kilowatts, towards which the plant now installed and authorised will provide 206,910 kilowatts, leaving 20,000 kilowatts to be provided by the end of the first period. During the second period of development it is anticipated that a total maximum plant capacity of 373,000 kilowatts will have to be provided. The additional plant required will be:—Blackburn Meadows, Sheffield, 30,000 kilowatts; Rotherham, ditto; new stations at Doncaster and Mexborough, 90,000 kilowatts, increasing later to 120,000 kilowatts. The system to be adopted will be three-phase alternating current, 50 periods, and the scheme will include provision for supplying the railways in the area with an extra high-tension supply into sub-stations at convenient centres.

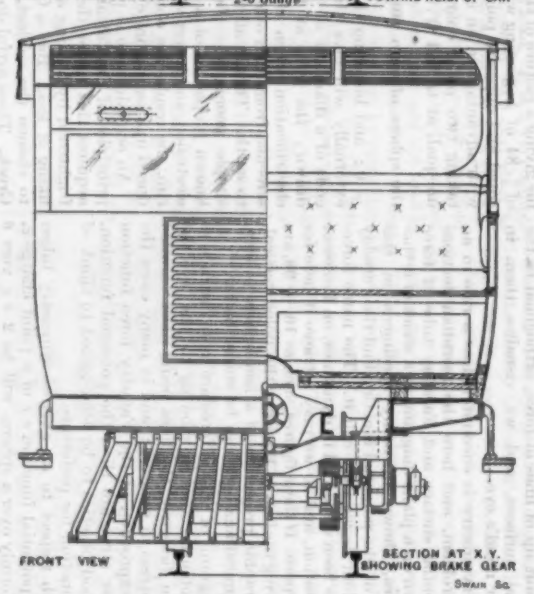
KALKA-SIMLA RAILWAY—50 HORSE-POWER PETROL RAIL CAR

THE DREWRY CAR COMPANY, LIMITED, LONDON, ENGINEERS

(*For description see opposite page*)







"THE ENGINEER"

Petrol Rail Cars for India.

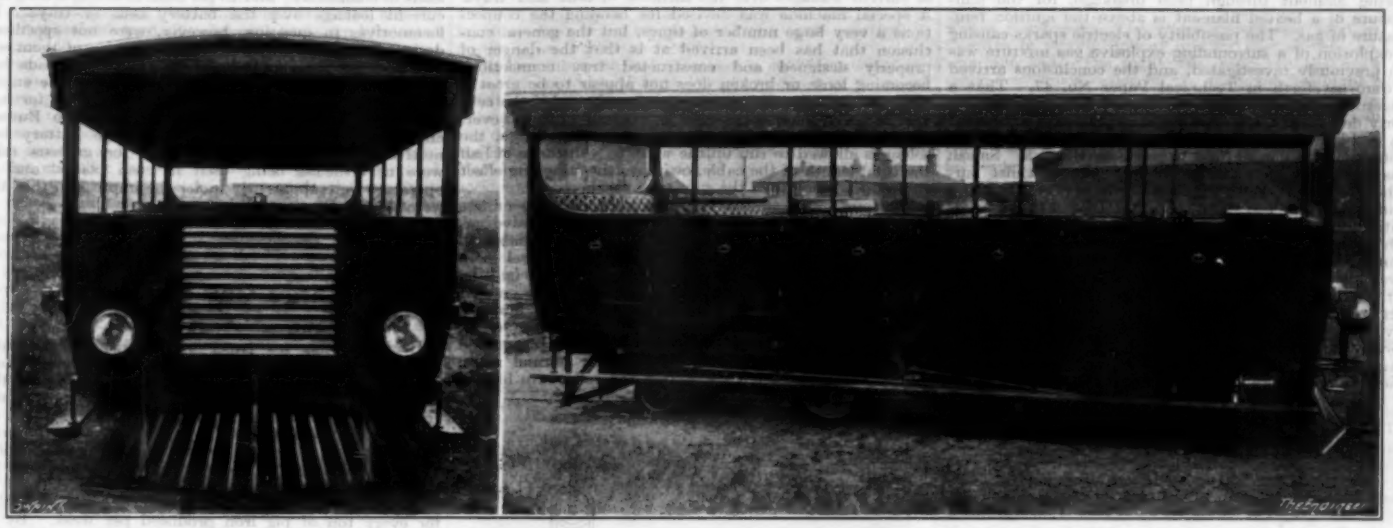
IN describing the Kalka-Simla Railway, which connects the East Indian Railway with the famous hill station, in our issue of November 29th, 1918, we mentioned the fact that the railway authorities were so pleased with the performance of some petrol rail cars, then in service, that it was intended to acquire some more powerful vehicles of the same class as soon as the manufacturing difficulties of that time had passed away. Two cars, which were ordered from the Drewry Car Company, Limited, of 13, South-place, London, E.C. 2, have just been completed and are the subject of the engravings on this page and the line drawing opposite.

The conditions of service which these cars have to meet are very severe, as the railway rises over 4600ft. in a distance of just under 60 miles. The ruling gradient is 1 in 33, not compensated for curvature, and the limiting radius of the curves is 120ft., while there is hardly a straight length of line throughout the route. The new cars are intended to carry sixteen passengers and a driver—although they will really seat nineteen passengers without discomfort—at an overall average speed of 18 miles per hour. Such a performance will reduce the time taken for the journey from the six hours of the steam mail trains down to about three and a-half hours for the petrol coach.

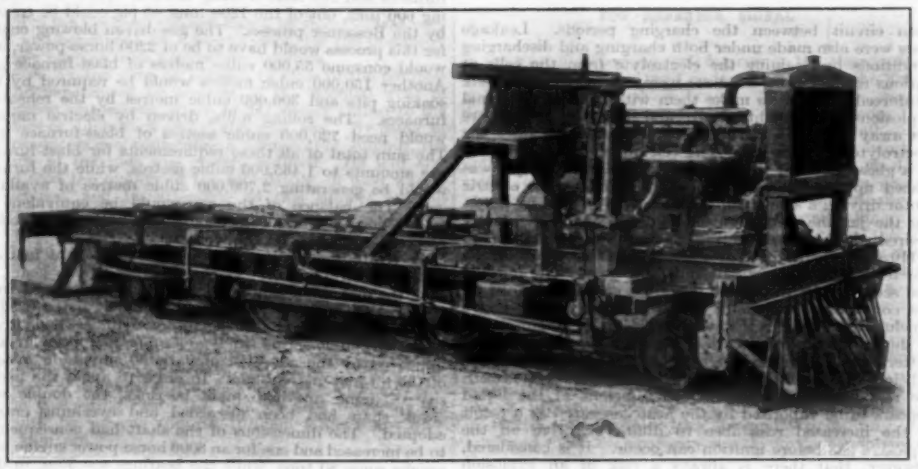
In order to provide the necessary seating accommodation the wheel base of the new vehicles had to be extended beyond the limits of the four-wheel arrangement generally associated with petrol rail cars, and two pony trucks were added on account of the sharp curvature of the railway. In this respect, we believe, the coaches under review are quite unique. The four inner wheels are coupled, by means of side rods, and thus all act as drivers. The size of the engine also is unusual for this class of service, a six-cylinder unit, giving from 45 to 50 brake horse-power when running on petrol, having been adopted. The cylinders are 4¼in. in diameter by 5in. stroke, and are cast, with their water jackets, in pairs. There are seven bearings for the main crank shaft, which is forged from 40-ton steel. The connecting-rods are of H section and have adjustable big-end bearings, while the small ends have phosphor-bronze bushes. The carburetter is of the Zenith pattern, specially arranged for working at high altitudes, and is fitted with an extra air inlet so that the engine can be used as a brake when descending inclines. The ignition is effected by a Simms high-tension magneto connected with one set of sparking plugs, while another set works in conjunction with an accumulator, coil and distributor. The magneto is so arranged that it can easily be removed for overhauling. An ordinary crank handle is provided for starting the engine, but an electric starter is also fitted. A dynamo provides current for lighting.

The power is transmitted from the engine to the driving wheels through two distinct gear boxes. One of these comes directly after the cone clutch and gives three speed changes, with a neutral position. The other gear-box is on a transverse shaft and is used for reversing. All three speeds are thus available in either direction. The connection between the two gear-boxes is effected by a "propeller" shaft and bevel gears, while the final transmission to the driving axle is by means of silent chains. It will be noticed in the drawing that the line of the propeller shaft changes at the universal joint and takes a downward direction. The object of this arrangement is to bring the transverse countershaft as low as possible and thus reduce the angle which the chains make with the horizontal, in order to minimise the effect on the chains of the driving axle rising and falling in the horn plates. The ratio of the gears is such that the engine runs at 1000 revolutions per minute when the vehicle is travelling at 16.8 miles per hour and the top gear is engaged. Hand screw brakes are fitted to the driving wheels in addition to the drum brake on the countershaft, which is operated by a foot pedal.

For the purpose of testing the performance of the new car the makers secured permission from the North Staffordshire Railway to have some trials on the Leek and Manifold Valley Light Railway, which, like the Kalka-Simla line, is of 2ft. 6in. gauge and has some stiff inclines with sharp curves. We were present at these trials, and although the conditions on the Staffordshire line are not so severe as those of India, there was every indication that the car would come up to the requirements. Going round the curves the pony trucks worked satisfactorily and a gradient of 1 in 41 was taken easily from a standstill. At the time of the trials the body had not been fitted to the chassis and the coach was very much in the condition shown in the illustration below. There was, however, a rough platform over the frame and this was loaded up with scrap iron to represent the fully loaded condition. Over and above this load there was on board a party of engineers and as many of the local people who could find something to hang on to. Since the trials the bodies have been fitted to the chassis and one of the cars has already been shipped to India.



KALKA-SIMLA RAILWAY—2-FEET 6-INCH GAUGE 50 HORSE-POWER PETROL CAR



CHASSIS OF THE CAR PREPARED FOR THE TRIAL TRIP

Hydraulic Testing of Drying Cylinders.

A QUESTION of much interest to engineers in the bleaching, dyeing and textile printing trades, relating to the periodical testing of drying cylinders, has just been settled to the satisfaction of those trades. Some months ago, the Home Office called the attention of the trades named to two explosions of drying cylinders which were attended with fatal results. One of these occurred as long ago as 1913, and the other was in 1917, and at the official inquiry into the latter explosion it appeared that no one called before the Commissioners was acquainted with certain recommendations made as a result of the first inquiry. These recommendations were :—

(1) That the area of the outlet safety valves should be enlarged because of the low pressure of steam in the machines.

(2) That periodical tests by hydraulic pressure should be made on the cylinders.

(3) That to enable these periodical tests to be made without dislocating the trade it may be desirable to have spare cylinders.

The Commissioners who inquired into the second explosion recommended that the cylinders should be tested not only after repairs but at suitable intervals, having regard to the age and the particular construction of the various cylinders. The Home Office thereupon issued to the trades a circular urging that cylinders—about 100,000 of which are in use—should be re-examined every two years. This provision naturally would involve a heavy burden upon the firms concerned, but while agreeable to take every precaution necessary for safety, they were, of course, anxious to be quite sure that the proposals of the authorities would have that effect. Moreover, the removal of the cylinders for the purpose of being tested would necessitate the provision of a large number of spares for use during the tests. The trades called into consultation Mr. C. E. Stromeyer, and on his recommendation it was decided to enter strong opposition to the proposals. Mr. Stromeyer's very emphatic opinion was that it was extremely dangerous to make periodical tests. Many explosions, he stated, had occurred soon after hydraulic testing at higher than working pressure had been made, and the presumption was that these tests started incipient cracks. Regarding the first recommendation given above, he argued that the size of the outlet safety valve was not fixed by the lowness of the pressure, but by the size of the inlet pipe. Mr. Stromeyer went thoroughly into the Board of Trade reports of exploded drying cylinders, and found that the majority of the explosions would not have occurred if the cylinders and their connections had been provided with properly working safety appliances.

Eventually a conference took place at the Home Office between the trade representatives and the authorities. The case made out was of such weight that the Home Office has now intimated that it will not press for the hydraulic testing of the cylinders where the users are opposed to such a test being made, provided that—

(1) Cylinders are periodically examined by a competent person.

(2) That certain provisions in a previous agreement with the trades are strictly adhered to. These are as follow :—On new machines the journals on the gearing side shall be provided with lubricators. Oiling while the machine is in motion shall be forbidden. Every set of drying cylinders shall be fitted with (1) a proper reducing valve or other suitable means to prevent the working pressure in it being exceeded (unless they are so constructed as to withstand with safety the full boiler pressure); (2) a proper safety valve; and (3) a proper steam gauge, the two last-named to be fitted between the cylinders and the reducing valve, if any. Such cylinders, valves and gauges shall be periodically examined by a competent person.

(3) The safety attachments fitted in accordance with the above are maintained in efficient working order.

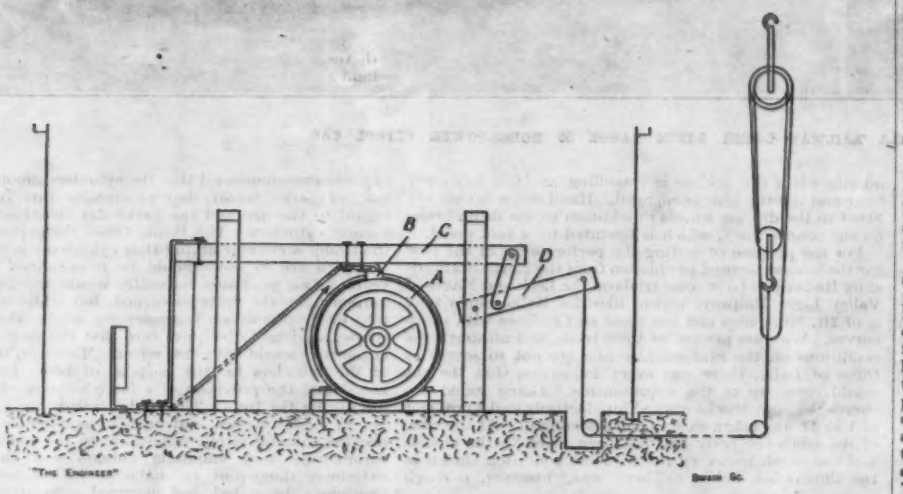
(4) The total area of the safety valves on any set of drying cylinders is not less than 1.25 to 1.50 times the total area of the inlet valves.

(5) A record giving in detail the result of the periodical examinations made by a competent person of the cylinders and fittings is kept and is available for examination by H.M. Inspectors of Factories.

THE Geneva correspondent of the *Economist* states that the 6 per cent. ten years Federal Railway loan proved a real success. One hundred million francs were asked for, and the public subscribed double the sum, so that the Government resolved to double the amount originally asked for. The proceeds of the loan will be used for the work of electrification.

The Safety of Electric Locomotives in Mines.

IN our recent series of articles on "Electric Trucks and Industrial Locomotives" it was mentioned that although battery vehicles are used to some extent in American coal mines, they are, on account of the risk of ignition where gases are present, a possible menace to safety. A paper recently issued by the American Bureau of Mines, however, describes a number of interesting tests which have been carried out with a view to discovering the weak points in these locomotives. Prior to these tests the Bureau investigated the danger that is liable to result from incandescent lamps, and an account of these tests was published some time back in Bulletin No. 52. The danger arises from the liability of explosive gas mixtures being ignited when allowed to come into contact with a glowing filament through bulb breakage, for the temperature of a heated filament is above the ignition temperature of gas. The possibility of electric sparks causing an explosion of a surrounding explosive gas mixture was also previously investigated, and the conclusions arrived at were set forth in Technical Paper No. 47. That a dangerous condition might easily arise from the use of a poorly designed or improperly fitted headlight equipment was well known, but it was considered desirable to obtain information that would aid in reducing the risk. Smash tests consisted of smashing lighted lamps whilst surrounded by the most explosive mixture of Pittsburg natural gas and air. Out of a total of fifty-six trials ignition took place in twenty-two cases. In tests made with lamps having concentrated filaments ignition occurred in all cases, whereas with lamps having distributed filaments ignition was only obtained in 27.7 per cent. of the total number of tests. The presence of the inert gas in the concentrated filament lamps did not prevent ignition. The tests proved conclusively that 125-volt lamps are a real danger if they are used on locomotives that may enter gaseous atmospheres, and that either the headlights should be protected so as to prevent breakage, or that some arrangement should be adopted that will interrupt the circuit before the bulb can be broken.



EXPERIMENTAL BRAKE FOR SPARKING TEST

In order to produce sparking conditions similar to those which are liable to occur when opening a headlight circuit, the current in a 125-volt circuit was interrupted between roughened brass and copper contacts at a speed of .39in. per second, whilst the contacts were surrounded by an explosive mixture of Pittsburg natural gas and air. Four hundred and forty interruptions were made with a current of .55 ampère before ignition took place, and when the current was reduced to .5 ampère 5000 trials failed to cause ignition. The tests indicated that the sparks resulting from opening 125-volt circuits carrying currents as low as .55 ampère can ignite gas, and also emphasised the need for careful wiring in the headlight circuit and the importance of not changing lamps in a gaseous section of the mine. Although the scope of the headlight tests was not comprehensive, the danger that may arise from broken bulbs was clearly demonstrated, and also the probability of the failure of safety devices that depend for their action upon lamp breakages. It was therefore concluded that a simple headlight of substantial construction, with a heavy, well-protected glass door properly guarded to minimise breakage, is more satisfactory than any other arrangement. It was also concluded that there should be no exposed conductors in a headlight, and that all the wiring should be enclosed in steel conduits or should be surrounded by flexible armour.

Tests were made to determine whether the sparks produced by mine locomotive brakes and wheels will ignite explosive gas mixtures. The first experiments were made with a standard mine locomotive fitted with special experimental brake shoes, but with the small amount of power available very little sparking could be obtained, and that which was produced would not ignite an 8.6 per cent. gas mixture. In subsequent experiments, however, a carborundum grinding wheel and various cast iron and cast steel blocks were employed to produce the sparks. A 7½ horse-power 250-volt motor running at 850 revolutions per minute was arranged to drive the 24in. locomotive wheel and a 13in. carborundum wheel in the manner shown in the accompanying drawing. The wheel A was mounted directly on the motor shaft and pressure was applied to the brake shoe B by means of levers C and D, which were operated from outside the gallery walls by a chain hoist. With this arrangement it was possible to manipulate the apparatus from the outside when the gallery was filled with explosive gas. Tests were made in this way with a 24in. standard chilled cast iron mine locomotive driving wheel, a 13in. medium carborundum grinding wheel, several brake shoes of cast iron and aloxite of different shapes and sizes and four steel wheels. The most intense sparking conditions obtainable with the equipment were produced in an explosive mixture of 8.6 per cent. gas without causing ignition. Large quantities of sparks were obtained from all the steel specimens, but the tests showed that sparks produced in this way are not liable to cause an ignition of gas. Other tests with different materials and with the absorption of more energy might give different results, but the tests that were made showed that the risk of danger was very slight.

Three possible sources of danger were investigated in connection with storage batteries, namely, the liability of arcs arising as the result of broken or loose connections, the liability of internal explosions of cells, and the risk of current leakages over the surfaces of cells and trays. A special machine was devised for bending the connections a very large number of times, but the general conclusion that has been arrived at is that the danger of properly designed and constructed tray connections becoming loose or broken does not appear to be great if the cells are inspected at proper intervals and if the cells are properly maintained. It is pointed out, however, that if, when soldering on the lugs to connectors, the solder is allowed to run up the wires to a distance of half the total length of the cable, owing to the stiffening effect so produced the life of the connectors is shortened.

All commercial storage batteries give off more or less hydrogen, and the presence of this highly explosive gas would be a grave source of danger if it were liable to ignite. When the electrolyte is at the normal level there is not much risk of arcs or other adverse conditions igniting the gas, and for this reason tests were only made on cells in which the level of the electrolyte had been lowered, representing a condition that might arise as the result of carelessness or accident. The electrolyte was evaporated by repeatedly charging the cells at their normal rates, and in order to hasten the action the cells were left on open circuit between the charging periods. Leakage tests were also made under both charging and discharging conditions by draining the electrolyte from the cells at various rates. Before the tests were started the cells were reinforced in order to make them withstand any internal explosions that might occur, and the containers were cut away or drilled at the bottoms in order to allow the electrolyte to drain out. The cell under test was placed in a glass jar filled with the electrolyte, and the jar was placed upon a table, which was lowered by an electric motor driving a screw and train of gears so that by lowering the jar the electrolyte could be drained out at any desired speed. The cells were in most cases connected to a 110-volt circuit through a series resistance, but on the last tests a pressure of 240 volts was used. The number and scope of the tests were not great enough to cover all the conditions that might arise in practice, or to give conclusive results, but they were sufficiently comprehensive to show that explosion is likely to occur in some types of batteries if the electrolyte is allowed to leak out until it is below the plates. In other types of batteries, however, the risk of explosion is less, as sufficient of the liquid appears to be vaporised by the heat generated as a result of the increased resistance to dilute or drive off the explosive gas before ignition can occur. It is considered, however, that there is always a risk of an explosion occurring if the circuit is allowed to remain open after the electrolyte has been allowed to drain off and a voltage is afterwards applied to the cells. The tests indicated that every precaution should be taken to guard against a low level of the electrolyte, otherwise the batteries are not safe when used in gaseous atmospheres.

As batteries give off a spray, especially during the charging period, and as this spray tends to keep the cells and trays moist, tests were made to ascertain whether accumulations of coal dust and electrolyte would permit a flow of leakage current sufficient to produce electric arcs and flashes or heat sufficiently intense to ignite explosive mixtures of methane and air. The experiments indicated that dangerous conditions are likely to arise with wooden leakage paths. Two distinct kinds of electrolytes were apparently tested, and it was concluded that in one case the risk of danger is much more pronounced than in the other case, but the exact nature of the two electrolytes is not specified. The tests also indicated that an accumulation of dirt on the cell tops is dangerous and uneconomical. The leakage of current causes both loss of power and rapid deterioration of the cells on account of the generation of heat and electrolytic action. Proper inspection and care of the battery are therefore essential.

Work previously done in connection with coal-cutting equipments was of great value in selecting the tests for the accessories of storage battery locomotives. The data obtained relative to controllers, rheostats, fuses, &c., had determined the general nature of the conditions that would be met with in testing similar equipments for battery locomotives, and made preliminary investigations of this apparatus unnecessary. Questions were, however, put to a number of engineers operating storage battery locomotives, and replies were received from about fifty-three users operating in all 240 locomotives equipped with various types of batteries. About 17 per cent. of the reports received showed that repairs to battery plates had been necessary, whilst 11 per cent. indicated that internal explosions due to a low electrolyte or short circuits of battery plates had occurred in battery cells. Sixty-four per cent. of the reports referred to cracked or leaky battery jars; 45 per cent. to trouble from broken leads or connectors; and 15 per cent. to arcing arising from current leakage over the battery cells or trays. The locomotives in question, however, were not specifically designed for use in mines, and since some of them were put into operation improvements have been made both in locomotive and battery design. Some of the engines referred to in the reports had been in service for more than seven years. Inspections made by the Bureau's engineers revealed the fact that storage battery locomotives which were not designed for gaseous mines were nevertheless being used in such places, and the operators were apparently under the impression that they were safe.

Large Gas Engines.*

IN introducing his paper on "Large Gas Engines," M. Kraft pointed out that the first large gas engine to be installed in the Cleveland district was made by his firm, and was set to work twenty years ago at the Ormesby Ironworks, of Cochrane and Co. It is still in service, and develops about 500 horse-power for blowing purposes. He went on to show how, with a blast-furnace producing 160,000 cubic feet of gas per ton of iron, of which only half is available, and an engine consuming 9000 B.Th.U. per brake horse-power hour, 5 horse-power can be obtained for every ton of pig iron produced per week. By the installation of boilers, heated by the exhaust from the gas engines and delivering steam to turbo-generators, from 16 to 18 per cent. could be added to the power output of the plant without it being necessary to burn any additional fuel. The efficiency of such a boiler, with its feed-water heater and superheater range between 55 and 60 per cent., and it will evaporate nearly 2 lb. of water per square foot per hour.

As an example of how the heat available in an ironworks should be utilised, the author took the case of a works comprising six blast-furnaces, each producing 200 tons of pig iron per twenty-four hours, together with Martin furnaces, converters, rolling mills, coal mines and coke ovens. The furnaces would require 1200 tons of coke per twenty-four hours, entailing the delivery of 1600 tons of coal. For this purpose the mines would require about 4000 horse-power. The coke-oven gas would amount to 210,000 cubic metres per twenty-four hours, and there would be sufficient tar to represent 50,000 cubic metres of gas for the purpose of heating the Martin furnaces. The gas and tar together would be sufficient for the production of 702 tons of Martin steel per twenty-four hours. Alternatively, 600 tons of iron could be dealt with in the Martin furnaces and 200 tons of scrap melted. Then the remaining 600 tons, out of the 1200 tons, of pig could be treated by the Bessemer process. The gas-driven blowing engine for this process would have to be of 2200 horse-power, and would consume 55,000 cubic metres of blast-furnace gas. Another 150,000 cubic metres would be required by the soaking pits and 300,000 cubic metres by the reheating furnaces. The rolling mills, driven by electric motors, would need 720,000 cubic metres of blast-furnace gas. The sum total of all these requirements for blast-furnace gas amounts to 1,465,000 cubic metres, while the furnace would be generating 2,700,000 cubic metres of available gas. The balance of the gas would be equivalent to 20,000 horse-power. Some, at least, of this power could be disposed of outside the works.

M. Kraft then went on to describe the salient features of the Cockerill engine. During the past twenty years, he said, the maximum power per engine had increased from 600 up to 8000 horse-power, four cylinders being used in the latter case. The single-acting cylinder had given place to double-acting, and governing had been greatly improved by the adoption of variable admission instead of the hit-and-miss system. In order to avoid the necessity of lining up three main bearings, the double web crank shaft had been discarded and overhung cranks adopted. The dimensions of the shaft had consequently to be increased and one for an 8000 horse-power engine now weighs some 80 tons, while the bearings are 35in. in diameter. The main frame, which is of the bayonet type, weighs 75 tons. The cylinders are characterised by the presence of through steel tie bolts which relieve the cylinder walls of all longitudinal tension stresses. They are fitted hot, and keep the metal of the cylinder walls always in compression. The inlet and outlet valve chambers are symmetrically placed in the cylinders, and are of a practically cylindrical shape. The valve seats are recessed into these chambers almost as far as the internal wall of the cylinder; in fact, as much as the valve lift will allow.

The piston is made of cast iron in two halves, each half butting up against a solid steel collar forged on the piston-rod, and secured to this and to each other by through steel bolts. The collar is large enough in diameter to allow the assembling bolts to pass through, and really forms the piston proper, the two cast iron hollow halves merely serving for water circulation, to carry the piston rings and to protect the piston proper from contact with the hot gases. The piston-rods are hollow bored, and the cooling

* From the paper by M. F. Kraft de la Saulx, of the Société John Cockerill, read before the Cleveland Institution of Engineers on January 10th, 1921.

water passes from end to end through both rods and pistons. At each end of each cylinder are stuffing-boxes and glands complete with metallic packing. Each packing ring, of cast iron, is in three pieces, held together by an outer cast iron spring ring.

The exhaust valves are of forged steel, hollow and fitted for water circulation. The inlet and outlet pipes are flexible armoured hose. The exhaust valve chests and seats are also water cooled. The valve gear is operated by a side shaft, driven from the crank shaft through gears, and running at half its speed. The old trip valve gear has been replaced for the sake of simplicity by a direct operated gear. This gear consists roughly of a cylindrical sleeve directly controlled by the governor, which opens more or less the gas ports and determines the amount of gas admitted, and the period through which it is admitted.

The lubrication of the cylinders, piston-rods, metallic packings and exhaust valve spindles is by multiple pressure feed pumps. Each point is lubricated by an independent piston, the flow from which can be seen and adjusted. The side shaft brackets are fitted with ring lubrication, and the excentrics and other small valve gear parts are lubricated by screw-down grease cups. The main bearing, outer bearing, big and little end bushes, and main crosshead shoes, are lubricated by pressure feed. The oil is drawn by two pumps, operated from the side shaft, from a reservoir to which it is returned after use, and where it is filtered and cooled.

The ignition is by high-tension magnetos. Each compression chamber has two sparking plugs, each operated by one magneto—completely independent the one from the other—which can be advanced or retarded whilst the engine is running. The starting is carried out by compressed air.

For the past fifteen years all the blowing engines built by the Cockerill Company have been fitted with the "Southwark" type blowing cylinders, with inlet and outlet grid valves. All the grid valves are cam operated, both inlet and outlet, and the movement is transmitted not directly, but through the intervention of actuating cylinders and pistons, which allow the air inlet valves to remain stationary at will, and the air to surge in that cylinder end. They also open the outlet grid valve when the air pressure in the cylinder equals the air pressure in the receiver. The variable air admission allows the engine to blow at increased pressure, when this is required by the blast-furnace, and to give a decreased volume of blast. In addition, the gas-driven blowing engines are fitted with a special type of governor, which allows the speed of the engine to be varied between considerable limits, that is to say, between 45 to 80 revolutions per minute.

In inviting Dr. Morley to open the discussion, the President, Major H. G. Scott, said that he thought M. Kraft had overestimated the amount of gas available. He had found that in the Cleveland district he could only rely on 27 per cent. of the total gas being available after the stoves had been heated and the blowing engines supplied with gas. The thermal efficiency of the stoves was 42 per cent. He also commented on the high piston speed, 900ft. per minute, adopted for the engines.

Dr. Morley spoke principally on the subject of mean effective pressures, which, he said, should be kept up with the object of reducing capital costs.

Mr. H. Crowe recalled a previous discussion on the heat balance of a steel works, which confirmed the author's estimates, and said that the Cleveland furnaces gave even more surplus gas than M. Kraft assumed. On the other hand, however, the open-hearth process would be used instead of the Bessemer converter in that district, and the furnace would require more heat than the Bessemer blower would consume. Even in these circumstances, Mr. Crowe thought M. Kraft's figures were on the safe side. He also agreed with Dr. Morley that it was necessary for the mean effective pressure to be increased beyond 50 lb. if power was to be produced at a low cost with gas engines. The design of the Cockerill exhaust valve, he thought, was very good and accounted, to a large extent, for the immunity of these engines from pre-ignition troubles.

Mr. J. Winton gave an account of some of the troubles he had experienced on account of the unequal wear of gas engine piston-rods, which he ultimately traced to the presence of sulphurous acid in the coal gas. By using in the producers coal containing a minimum of sulphur, the wasting of the rods was greatly reduced. He had also found that the quality of the lubricating oil used was of importance, and by attending to this subject he had succeeded in getting an engine to run for two years and four months without taking a valve or cylinder cover off.

Mr. A. Hutchinson said that he thought gas engines would be more generally adopted as blast-furnacemen became more practical, but thought the price of the engines was against them.

Mr. S. H. Fowles, however, claimed that a gas power station working on surplus gas could completely wipe off its capital expenditure in two or three years.

In replying to the discussion, M. Kraft described how, in a case in which he had been troubled by sulphuric acid in the gas eating away the rods, he had overcome the difficulty by passing the gas through large boxes filled with iron ore.

Fog Signalling on Railways.

COLLISIONS on the railway during fog are now not as frequent as they were. This fact is not, however, due to the signalling arrangements having been improved, but to the reduced frequency of fogs. As a matter of fact, the signalling is to-day exactly as it was fifty or more years ago. We still rely generally on the fogsignalman and his detonators and hand lamp, and even these arrangements are not as perfect as they were, for the reason that now, where the signals for two lines are near one another it is the custom for one fogman to attend to both lines. He places the detonators for one line on the rails by hand and those for the other by a machine which he has in front of him. So far as detonator laying is concerned, this arrangement is quite effective, but it is out of the question for the fogman to give the prescribed hand signal to a driver on the line served by the machine. A weakness in fog signalling has always been that when the signal that is being "fogged" is pulled "off" the fogman removed the detonator from the rail. Thus, when the detonator is laid on the rail by machine a driver, if the signal be "off," gets neither explosion nor hand signal. As a consequence, should the fogman not be on duty—as, for instance, when a fog comes on suddenly—and the driver cannot see the signal, he has some justification for assuming that he has a clear road, when actually the signal is against him.

What is known as automatic train control is a development of the idea of providing in the cab of locomotives some means whereby in fog the driver may know the condition of the signals he is passing. The first of the few successful schemes for this purpose was that invented in 1906 by some Great Western Railway officers, and now installed to all the distant signals between Paddington and Reading and also on some of the Great Western branch lines. Such an arrangement not only assists a driver at all times, but particularly is it useful when fog comes on suddenly and the fogmen have not had time to arrive at their posts. It also saves fogmen, and this fact, in these days when wages are higher and overtime is costly, is an important factor.

On December 8th last there was a collision at Barking in a fog, on which Colonel Pringle reported in terms we noted on page 286 of our issue of March 18th, and on February 3rd there was a collision near Waterloo during the dense fog of that evening. Major Hall reported on the latter, and his report was alluded to in the "Railway Matters" column of our issue of April 15th. Both these accidents might have been avoided had the engines been provided with cab signals. Whilst the Departmental Committee, now sitting on automatic train control, is concerned mainly with the larger question of guarding against a driver passing stop signals at "danger," it will, no doubt, have also in mind the necessity in fog of the driver being satisfied that his signals are at "clear"; in other words, that the safety indications are provided for just as much as are the danger signals.

Meanwhile, it is of interest to note what has been done

FOG REPEATER SIGNAL

in the way of dispensing with fogmen on the Metropolitan, Metropolitan District, the London Electric and the Ealing and Shepherd's Bush railways. Fogmen are usually drawn from among the platelayers, partly because they are more accustomed than any other grade to walk about the track, and partly because their ordinary work is mostly suspended during fog. But on lines of dense traffic, such as those just mentioned, there is a greater proportion of signals than platelayers. Practically all these lines are protected by automatic signalling, and therefore there are no signalmen. Consequently, the rule requiring the signalman, should a fogman not be on duty, to put a detonator on the rails, cannot be followed. These difficulties were in part met by the provision of a fog-signalling machine, which put detonators on the rails whenever the signal was "on" and withdrew them when the signal was "off." The machines required charging from time to time, and this fact was felt to be a weakness. What has now been done on these lines is to provide a fog repeater—"repeater" being the term applied to the signals usually known as "distants." These repeaters were first introduced on the Metropolitan Railway, and are fitted to all the necessary signals on the Circle and on the main line between Baker-street and Harrow inclusive. On the Metropolitan District and its allied tubes and on the Ealing and Shepherd's Bush there are now no fog-signalmen nor fogging machines.

The accompanying illustration shows a fog repeater in use on the Ealing and Shepherd's Bush line, which is fixed at a certain distance—in this case it is 200 yards, but on the District and the tubes it is 100 yards—in rear of the signal that has to be repeated. This device repeats the condition of Signal S.81, seen with a white background near the bridge in the distance. The post is about 10ft. above rail level, carries a lamp with an upper, yellow, and a lower, green, lens. The yellow light appears so long as the signal is in the "danger" or "caution" position; the lower, green, light is shown when the signal is at "clear." The lamps in the repeaters burn only when there is a fog, being switched in by the signalmen who are responsible for all the repeaters in a given area. The lenses are 6in. diameter, the voltage for the lamps is 105, and the lamps are 30 watts. They are made by the McKenzie, Holland and Westinghouse Power Signal Company, Limited, 82, York-road, King's Cross, N. 1.

Where there is the necessary power for lighting and the requisite space for the posts, these repeaters could be used on the main lines. It should be pointed out, however, that steam railways labour under two disadvantages compared with electric railways:—(1) There is the smoke from the locomotives which may interfere with the view of the repeaters, and (2) steam lines are not equipped with the automatic train stop which would pull up an electric train in its own length, should the motorman miss the repeater, and, as a consequence, overrun the signal.

IMPROVEMENTS IN THE LIFEBOAT SERVICE.

A SHORT time ago one of the Royal National Lifeboat Institution's motor caterpillar tractors for launching lifeboats was sent to the station at Hoylake, and a night practice was recently held, which has shown the value of these additional helps to life-saving. The practice was carried out exactly under service conditions. No notice was given to the crew, and a night was chosen when a strong on-shore wind was blowing and there was a rough sea. The alarm rocket was fired at five minutes to eleven, and at quarter past eleven the boat was launched. The night was dark, but the work was made very much easier by the acetylene headlight which the tractor carries. Not only was it found that the boat was more easily and more promptly launched than had ever been possible with horses, but that in the surf the tractor was able to push the boat carriage further out than horses had been able to take it.

For some time past the Institution has been experimenting with various mechanical devices for effecting communication between the lifeboat and the ship in distress, and has now adopted a line-throwing gun which has been designed to its requirements by the B.S.A. Company. This gun will be able to throw a half-inch line from 60 to 80 yards in all conditions of weather. When it is remembered that in the past a lifeboat has often had to lie off a wreck through a winter's night, in the teeth of a gale which made it impossible to get any nearer, or to do anything to help the crew in distress, the value of this new device for saving life will be realised. The gun is very simple. The line is coiled up in a tin cylinder which fits over the barrel, the end of the line being attached to a hollow steel projectile having a rod down the centre. This rod is slipped down the barrel, and the projectile is fired from the gun with a cordite cartridge. The gun, complete with the projectile and the cylinder containing the line, is light enough to be fired easily from the shoulder, being about the same weight as a Service rifle, and has a very slight recoil. With this new device the Institution hopes to have solved what has been a problem in life-saving from shipwreck for many years. One of the new guns is being sent at once to each district, and when its uses have been demonstrated to the crews a more or less general distribution of the gun will be made.

VESSEL BUILT IN SHANGHAI FOR NORWAY.

THE steamer Hervar, the seventh of a fleet built at Shanghai to a Norwegian order, was successfully launched from the slips of the New Engineering and Shipbuilding Works, Limited, on April 13th, according to the *North China Daily News*. The Hervar and her sister vessels are being built to Det Norske Veritas highest requirements, the leading dimensions being:—Length overall, 254ft. 6in.; length between perpendiculars, 242ft. 6in.; breadth moulded, 37ft.; depth moulded, 17ft. The vessels are divided into six water-tight compartments, and are provided with a cellular double bottom for water ballast extending right fore and aft. The deadweight carrying capacity is 2000 tons and a speed of 10 knots is easily obtained under loaded conditions, the average speed obtained on trial under ballast being 11¾ knots. The vessels are built with clear holds and the hatches are made specially large for the quick handling of cargo. The propelling machinery consists of one set of triple-expansion surface-condensing engines, having cylinders, 18½in., 29in. and 49in. by 33in. stroke, capable of developing 1100 indicated horse-power. Steam is supplied from two cylindrical return-tube boilers, each 12ft. 6in. diameter by 10ft. 6in. mean length, working under natural draught and designed for a pressure of 180 lb. per square inch.

NEW SEA ROUTE TO THE CONTINENT.—The ss. Bruges reached Harwich on the morning of Monday, July 4th, after having been to Zeebrugge and back, thereby inaugurating the Great Eastern Railway Company's new short sea route to the Continent. Sailings are made thrice weekly in each direction, on Mondays, Wednesdays and Saturdays outwards, and on Tuesdays, Thursdays and Sundays inwards. Leaving London—Liverpool-street—at 8.40 p.m., Zeebrugge is reached in time to catch the 6.10 a.m. connecting train for Bruges, Brussels and beyond, and in the reverse direction leaving Zeebrugge at 11.30 p.m., passengers arrive in London at 8 a.m.

SCHOLARSHIPS IN NAVAL ARCHITECTURE AND MARINE ENGINEERING.—At the present moment it may be opportune to call attention to the scholarships that are now available to apprentices and students in shipbuilding and marine engineering, ranging in value from £100 to £150 per annum, which are offered annually by various firms or by endowment, and which are administered by the Council of the Institution of Naval Architects. They are awarded either on the results of the Board of Education's examinations in specified subjects or on certain papers set in the matriculation or entrance examination at the colleges or universities where the scholarships are usually tenable, viz.:—Glasgow University, Liverpool University, Armstrong College (Newcastle-on-Tyne), City and Guilds (Engineering) College (South Kensington). Some of these scholarships have been in existence for upwards of twenty years, while others have only recently been established, but the number of candidates that come forward and compete is not large, having regard to the value of the scholarships and to the great number of apprentices and students who are engaged in shipbuilding and marine engineering. It may be pointed out that all the students who have won these scholarships in the past have uniformly succeeded so far in making good in their profesional career, and it is felt that further attention may usefully be called to this subject in order that the field of candidates may be broadened and that greater interest may be taken by those who desire to promote the welfare and progress of our young shipbuilders and engineers. Two scholarships in naval architecture and two in marine engineering are now offered for competition, the entries for which close on July 31st. Full particulars and forms of application may be obtained from the secretary, Institution of Naval Architects, 5, Adelphi-terrace, W.C. 2.

JAMAICA RAILWAYS, EIGHT-COUPLED LOCOMOTIVE

MR. P. C. DEWHURST, KINGSTON, JAMAICA, ENGINEER.

Locomotives for the Jamaica Government Railways.

WE illustrate some locomotives built by the Canadian Locomotive Company in 1920 for the Jamaica Government Railways, to the general requirements of design and dimensions of the Locomotive, Carriage and Wagon Superintendent, Mr. P. C. Dewhurst, and including a number of special features specified by him to meet the difficult conditions of the Jamaica Government Railways main line. The builders were responsible for the constructional features, as is customary with American and Canadian builders.

These engines are of the maximum capacity permitted by the character of the line and its permanent way and develop a rated tractive force of 32,953 lb. at 85 per cent. of boiler pressure, which is high for the limitations of 13¾-ton axle loads and curves up to 240ft. radius. They ordinarily haul 195–205 tons on continuous gradients of 1 in 30 with practically continuous reverse curves of 340ft.–270ft. radius (uncompensated) over various stretches of 6 and 7 miles at 10 miles per hour. On comparatively level sections of the line the loading is 1740 tons at 15 miles per hour. In them are combined various features of flexibility and control which are commonly used independently.

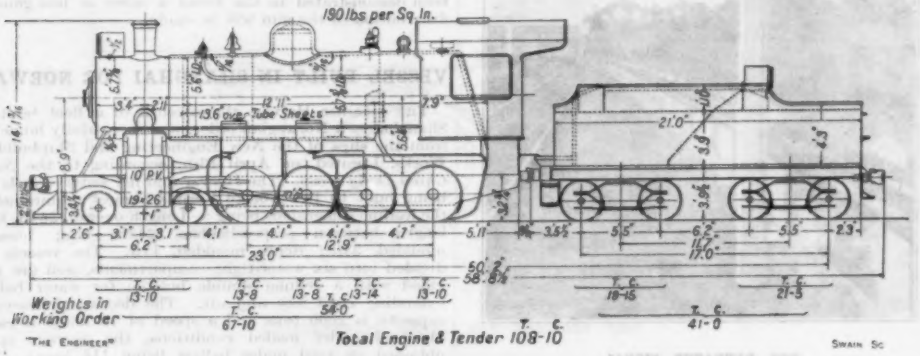
The bogie is of the swing link type, the links being carried on double suspension pins; this type of suspension, by providing considerable resistance or "pull," enables the bogie to do the whole of the curving, and the flanges of the intermediate coupled wheels, which are the first flanges of the rigid wheel base when running forward, do not ordinarily bear against the outer rail on even the sharpest curves. The comparatively large initial effort required to raise the engine on one of each pair of suspension pins effectually prevents the engine "nosing" on tangents between curves or on long lengths of straight track.

To shorten the rigid wheel base and to allow the bogie alone to control the engine on curves the leading coupled wheels are flangeless, the tires being 6½in. wide on the tread. The intermediate coupled wheels and the main driving wheels have normal flanged tires 5½in. wide. They constitute the rigid wheel base. The rear coupled wheels have normal tires and flanges, but in order to distribute the work of "curving" amongst two flanges when running backwards, thus lessening flange and axle-box wear, their axle-boxes have ½in. lateral play. Curves of no more than 240ft. radius are taken at 14 miles per hour when so running. The effective rigid wheel base being only 4ft. 1in., the bogie has full control when running forward, and the engines have practically the same freedom on curves as an articulated locomotive. The rear coupling rods have no extra knuckle joints to provide for lateral movement, but have an allowance of side play ½in. more than the rear wheels, the revolving movement of which, when running, allows the coupling rods to traverse the crank pins and maintain their position in correct alignment.

The boilers are fitted with mild steel fire-boxes, the stays being of stay bolt iron; all tubes and flues are of seamless steel and are electrically welded to the fire-box tube plate after the usual expanding and beading. The fire-box roof is supported by crown stays of the direct radial type with button heads inside the fire-box, the four front rows being independent expansion stays. The fire-hole is of the "Webb" dished pattern. Circulating tubes are provided in the fire-box. Rocking grates of the finger type, with dump plates at the front end, operated from the footplate, are fitted.

Boiler feed is supplied by two 9½ mm. self-acting injectors of the lifting type placed in the cab and delivering to combined top-feed clack boxes with a spraying device inside the boiler. The overflow from the injectors is led into the ash pan, where it is arranged to flush the sloping surfaces and also, if necessary, to flush between the rails to prevent or extinguish fires in the track. Pet pipes are fitted in the overflow for the enginemen's observation.

Inside admission piston valves, 10in. diameter, operated by Walschaerts valve gear, control the steam distribution. Piston-rods of extended pattern are fitted, thus enabling the pistons to be examined and the rings renewed without breaking the crosshead joint. The piston and valve spindle packing is of the two-piece floating type. The crosshead slipper bearings are of cast iron.



WEIGHT DIAGRAM OF EIGHT-COUPLED LOCOMOTIVE

The tender tank is of U shape, but the fuel space is of the self-trimming design. Some of the engines are to be equipped to burn oil fuel on Holden's and the Scarab systems, and one of the others is being fitted with an air-operated fire-door for trial purposes.

The principal dimensions—additional to those shown on the diagram—are as follows:—

Engine.

Cylinders (2), diameter and stroke	19in. by 26in.
Coupled wheels, diameter on tread	3ft. 10in.
Bogie wheels, diameter on tread	2ft. 2in.
Rigid wheel base	4ft. 1in.
Semi-rigid wheel base	8ft. 8in.
Driving and coupled journals	8½in. by 10in.
Tubes (164), outside diameter	2in.
Flues (26), outside diameter	5½in.
Circulating tubes (3), outside diameter	3in.
Superheater tubes (104), outside diameter	1½in.
Heating surface—	
Tubes and flues	1642 square feet
Fire-box and circulating tubes	146.5 square feet
Total evaporative	1788.5 square feet
Superheating surface	310 square feet
Equivalent heating surface = total heating surface + 1.33 superheating surface	2308.5 square feet
Grate—	
Length	6ft. 2⅝in.
Width	5ft. 5½in.
Area	33.8 square feet
Working pressure	190 lb. per square inch
Tractive force at 85 per cent. of boiler pressure	32,953 lb.

Tender.

Wheels, diameter on tread	2ft. 9in.
Water capacity	3500 gals.
Fuel capacity	6½ tons
Ratios—	
Adhesion weight / Rated tractive force :	
At 85 per cent. boiler pressure	3.67
At 75 per cent. boiler pressure	4.16
Rated tractive force at 85 per cent. / Equivalent heating surface	14.27
Total evaporative surface / Grate area	52.9
Gauge	4ft. 8½in.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Iron and Steel Masters and Cheaper Fuel.

IT looks very much as if the three months' conflict just now ended between the masters and men in the coal trade will be succeeded by a trial of strength between the coalowners and the manufacturing interests. The temporary inflation of the coal market will no doubt give place to more equable conditions when the shortage has been overtaken. Ironmasters do not seem at all inclined to prolong the period of strain by competing for supplies at famine prices. Manufacturers declare they are prepared to keep their plants idle indefinitely rather than pay prices for fuel which they cannot afford, and which prevent them from producing at a competitive price. It is recognised that the iron and steel trade has to fight for its existence, and that its well-being can only be re-established by bold sacrifices of price. Some earnest has been given of readiness to face the sacrifice, and we may expect rapid advance now in the process of deflation, which must precede a sound stabilisation of prices, based on cost of production. Everything, or almost everything, depends upon the cost of coal. The question of cheap coal is now, indeed, of paramount importance, iron and steel manufacturers declaring that foreign competition cannot be met until they obtain fuel at 15s. to 20s. per ton. The main factor in the revival of the iron and steel trade is the ability of the coalfields to produce plenty of the cheaper fuel for industrial purposes. Birmingham manufacturers and merchants are quite confident that the price of fuel will suffer a big reduction in the near future. Indeed, some ironmasters are not without hope that industrial coal will eventually return to somewhere in the neighbourhood of £1 per ton, and that slack will be below that figure. With this in view, orders are not expected to be too plentiful until fuel has reached its lowest level.

Raw Iron Smelters Indisposed to Restart.

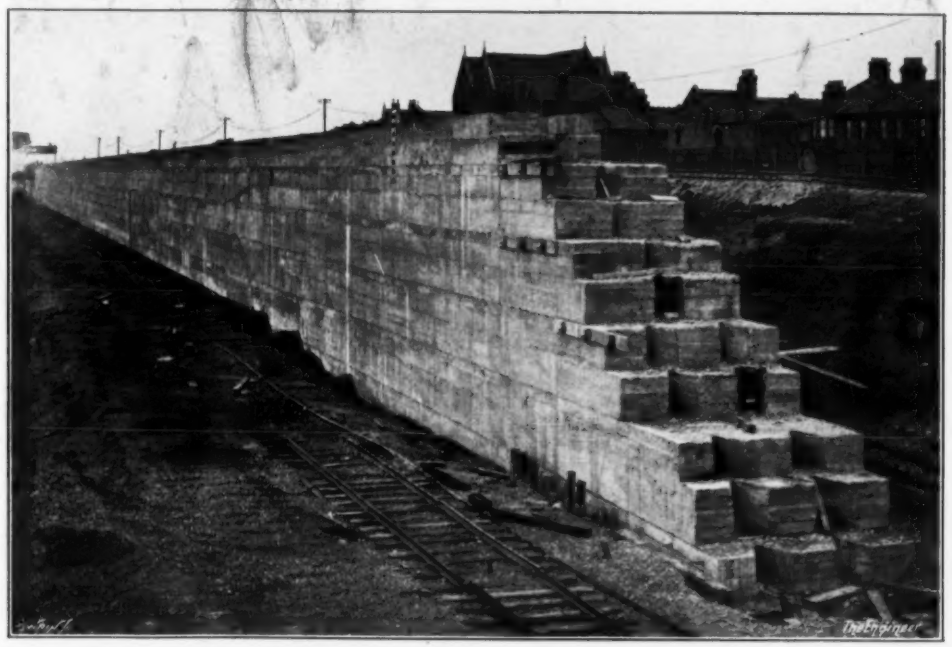
Home supplies of pig iron have been sold out, except for small odds and ends. Weeks must elapse before furnaces can be got into regular production again, even if smelters were prepared to re-light them. They are, however, complaining that they cannot afford to produce at the present price, and they are not at all disposed to re-start blast-furnaces until production costs come down, and they can see their way to carry on without incurring an actual loss. It will be remembered that many furnaces were blown out some time before the strike, because every ton of iron produced involved a substantial loss. The crux of the problem is in coal and coke, and it is absolutely essential for the iron trade for fuel prices to be considerably reduced. Nothing in the coal negotiations has indicated what the future price of coal and coke is likely to be. The coalowner professes to be altogether in the dark as to the lowest price at which he can afford to sell his coal, until he knows something more about the output obtainable under the recent settlement. In the meantime, he sees an opportunity of recouping some of the heavy losses sustained during the past three months by means of the highly remunerative price at which he can sell his coal. One coalowner has said that he is overwhelmed with offers to take all the coal he can get at £2 10s. a ton. As the ironmaster before the strike could not make iron profitably with coal at £1 15s. per ton, and demands a substantial reduction on this, the coalowner is disposed to turn a deaf ear to this class of customer until he has handled as much as possible of the more profitable business. It is recognised, all the same, that coal prices will have to be cut severely. One suggestion is that the trade being now self-controlled, will return to the former grading system, under which the householder got his coal at a higher price, in the interests of manufacturers, who bought their works coal comparatively cheaply. It is believed in the Midlands that that will be the solution of the problem, but, in the meantime, there is no probability whatever of renewed activity in the iron trade for some time. It is nearly impossible at present to buy pig iron, and no keenness is shown by anyone concerned. The holders of small stocks of forge iron believe they will sell more profitably somewhat later, as the scarcity of pig iron increases. The most cheerful circumstance for the moment is the brighter outlook with regard to the engineering wages question. This is a matter of great importance in view of the large consumption of pig iron by foundries. If the engineering shops become busy, local furnace owners may be encouraged to re-light blast-furnaces in Staffordshire to supply foundry iron. Rather big contracts have been arranged for the supply of Belgian pig iron to the Birmingham district. There is a good quantity of this material coming in, Belgian No. 3 being offered at 145s. or less, and inferior grades at 120s. American pig iron is now quoted at the very low rate of 20 dols. at furnace. It may be possible to import this on competitive terms with British material, particularly if the American rate of exchange improves.

Manufactured Iron.

The reduction in the price of unmarked bars has made little, if any, difference in the immediate outlook in the finished iron market. The reduction in the price of nut and bolt bar iron has caused considerable dismay among the makers in this district, who complain that they have been forced into consenting to the reduction against their will, and inveigh against the continental competition which has made it necessary. They assert that they have been compelled by the influx of cheap products from continental producers to reduce their prices substantially below net manufacturing costs. The ironmaster states as definitely as ever that business on the basis of recent full quotations is quite impossible. The maker of unmarked bars sustained losses when the figure was £19 per ton. With the price reduced to £16, the manufacturer looks forward to a long period of stagnation. Some firms have already informed their customers

PORT OF LONDON—ROYAL ALBERT DOCK EXTENSION

EARLY STAGE OF MAIN DOCK WORKS—MARCH, 1914



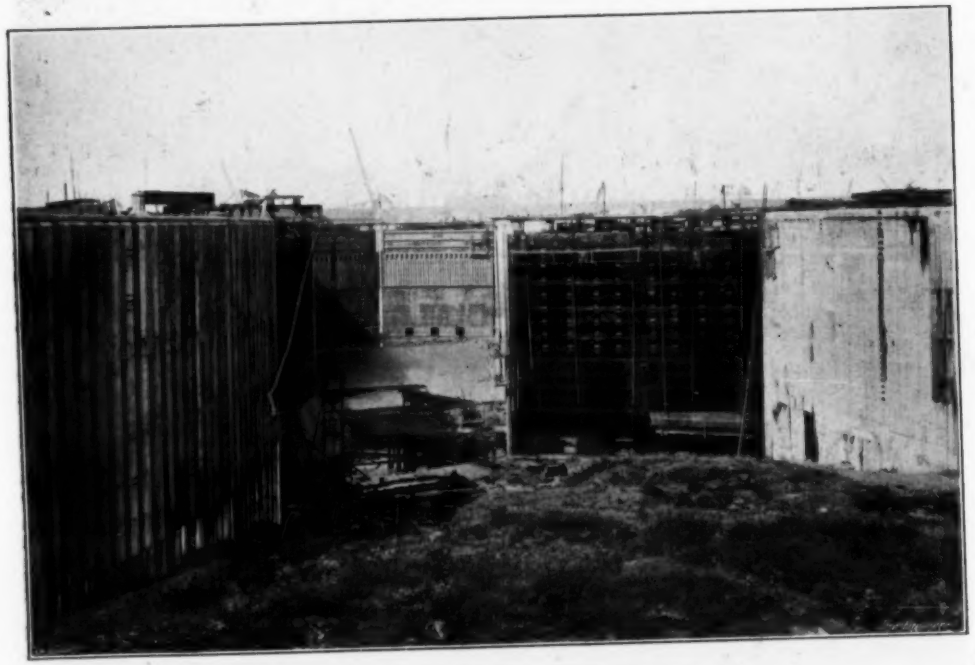
CONSTRUCTION OF QUAY WALLS—JUNE, 1914

GOLIATH CRANES USED DURING DOCK CONSTRUCTION

GOLIATH CRANES USED DURING DOCK CONSTRUCTION

ENTRANCE LOCK WORKS—APRIL, 1915

REINFORCED CONCRETE JETTIES ON SOUTH SIDE OF DOCK—MAY, 1919



ENTRANCE LOCK WITH GATES IN POSITION—SEPTEMBER, 1920

GRAVING DOCK AS COMPLETED IN APRIL, 1921

of their intention to shut down for an indefinite period. A large firm of iron merchants has received an intimation from a Staffordshire ironworks concern that, as it is impossible to produce profitably, it has decided to close its works until conditions improve. One or two Staffordshire marked bar forges and mills, which are favourably situated, have commenced operations this week. Most of them can command their own coal supplies. Iron gas tube strip has been reduced to £20 per ton, a drop of £2 to £3 per ton. This follows upon the reduction of £3 in Lancashire hoops, and is also to be regarded as a direct corollary of the reduction of Crown bars to £16 in all the iron districts of the country. The signs of a revival of demand for galvanised sheets continues, and prices have appreciated a further 40s. a ton to £26 for sheets of 24 w.g.

Steel Outlook.

There is a large world demand for steel, but it is potential rather than actual at present. The whole thing is a question of price. Coal at £1 per ton would go a long way towards converting a potential into an actual demand. The war wastage, combined with the low production of to-day, has made a shortage of steel in the world markets which will have to be made good, and that right soon. Yet many of the steel works cannot make steel profitably at present prices. One of the North-Eastern steel works, especially laid out for economical production, has, however, informed its Birmingham customers that it is now prepared to accept specifications. Steel strip is now down to £17 per ton, and it is stated that outside the Association this price is shaded. Belgian supplies are offered at about £13. Belgian bars for nut and bolt work continue to come in as low as £10 10s. per ton, a figure several pounds above the local quotation. At present the world's prices for steel is set by the continental makers. There is a slight tendency for quotations to become firmer, and the latest reports from the Continent state that the French and Belgian producers are considering closing down their works rather than continue to manufacture at rates which, they state, yield them no profit. These interests also declare that the Germans are selling for export at figures below the cost of production, even allowing for the depreciated German exchange. Many factors, therefore, point to an inevitable strengthening of prices. On the other hand, the demand, although showing signs of improvement, is still slender.

Engineering and Wages Costs.

There exists in the Midlands an impression that as the labour troubles adjust themselves, there will be a revival in the engineering trade. It must, of course, be very gradual at first, but it is expected to culminate in something approaching a boom next year. The price of engineering commodities will, with decreased working costs, sympathetically recede. The question of wages reductions which is now occupying so prominent a position is a factor which will have much to do with any chances of a return to prosperity for the industry. It is hoped on all hands that a stoppage will not occur, and it is recognised on all hands that wages must be regulated by what the trade will bear. As long as they obtain that, and as long as what the trade will bear represents at least a living wage, the men will have no just cause for complaint. The recommendations which the men are now advised to confirm are considered by Midland engineers to be quite satisfactory, though master engineers point out that in a sense the new scheme of wages adjustment will be but temporary, even if the men approve of it. Its effect is to authorise reductions in July and August, equivalent to those already accepted in the shipyards, leaving over the problem of the disputed war bonuses for consideration in September. Instead of automatically disappearing three months hence, these bonuses, awarded at a time of great prosperity on account of the general condition of trade, will come up then for reconsideration. Although when September comes, the question will very probably be found still to present difficulties, the proposal is so eminently just and reasonable that the men may surely be expected to agree to it without demur.

Coal.

As far as possible, having regard to the state of the pits, there was a general resumption of work in the coalfields this week. Many of the men are back at work in the Warwickshire pits, and conditions at the various collieries are gradually becoming normal. The majority of the miners in South Staffordshire are unable to return to work owing to a dispute between the coalowners and the colliery enginemen and underground firemen. The men, members of two unions, have declined to resume pending the result of negotiations respecting a local agreement, which expired in April. The men state that they are willing to accept the national settlement, but they want a renewal of the agreement. This the owners, it is understood, are not prepared to grant under the new conditions. Although it is difficult to state a time by which normal work will be proceeding in the mines again, the general opinion seems to be that from four to six weeks will be necessary in the district surrounding Birmingham. There is, besides, a certain number of mines which it will never pay to recover, and it is very doubtful whether even the 1920 output figure of 229,503,435 tons will be approached this year. The only way of making up for the thirteen weeks of stoppage is the raising of an increased output per man for the remainder of the year. In many of the mines no one had, until Monday, been down since March 31st, and in this area it has been found that the roads in many of the collieries are in a rather bad way, and much repair work has to be done.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER, Thursday.

Iron, Steel and Metals.

THE general position in the iron and metal markets is not yet greatly altered by the rather favourable events of last week, and the reason appears to be that no one knows yet at what prices industrial coal and coke are to be supplied. This is an important point, and it is fairly clear that the arrangement about wages will not allow of generally low prices for fuel; that is to say, prices anywhere near those upon which our manufacturing interests can flourish. It is possible that the prices for industrial coal and for slack may be reduced to a figure sufficiently low by keeping up the price of house coal, and this may be the policy to be pursued. If so, there is some chance for a revival in trade, and the re-capture of those markets abroad which are being supplied now by America and the continental producers.

Metals.

The immediate future of the non-ferrous market will depend a good deal upon whether or not the above-mentioned view of the fuel situation is correct, for it cannot be flourishing here while iron and steel are so much dearer than in America and in Germany and Belgium. The copper market has responded to a certain extent to the influence of a better labour outlook, and a rise of from £2 to £4 per ton in standard and refined copper has taken place, but the actual prices are not now so high as they were at the beginning of June, when there was no immediate prospect of the end of the coal dispute. Copper, however, is in a far more favourable position for an advance than many other metals, and the reports from America suggest that the burden of heavy unsold stock has been lifted to a large extent. The output of American copper during June has been comparatively trifling, and there is a good chance that the July figures may be small also. The consumption in Germany is going ahead, and the market should prove sensitive to the beginnings of a revival in British consumption. This might easily come during the next two months, and although we cannot expect to have any universal revival in trade here until iron and steel are much cheaper, there may be a sufficient revival to affect the present low prices of copper. There is still a very large quantity of scrap copper and brass waiting to be sold, and most dealers in old metals seem to be full of stock and very disinclined to add to it. As a consequence, the prices of old copper, and especially of old brass, are much lower than they should be under normal conditions. If, however, there should be any revival of business as a result of the supply of fuel, these accumulations would soon be cleared at present prices, for they offer considerable advantages over the use of new metal. This is particularly the case with yellow brass scrap, which is being bought by dealers at about £25 to £30 per ton below the cost of making such metal from new materials. In the tin market there was a small appreciation of the price as a result of the settlement of the coal trouble, but it has not amounted to very much. It is, however, probable that a considerable amount of buying will soon have to be done by the South Wales tin-plate trade, for that trade had been selling some of its stock of tin while there was no possibility of using it. It cannot be expected that South Wales will be a large consumer of tin while plates can be manufactured cheaper in America than in Great Britain, but the fact of the district being a buyer of tin instead of a seller will make a difference. The stocks of tin in the East do not seem to have been reduced yet, the whole of the demand being met out of current production, but they are very strongly held, and there is no immediate probability of their being forced on the market. The markets for lead and spelter have not yet moved to any extent, but the demand is improving. Consumers of spelter in the galvanising trade may probably be more active buyers during the next few weeks, and this should have a very decided effect on the spelter market, especially if German sellers still hold off. The price of galvanised sheets (£22) is not so extravagant as it was.

Pig Iron.

The position in the pig iron market is no clearer than it was before; in fact, there seems to be rather more confusion, and no business is being done. Information as to the new prices for furnace coke is lacking, but there is a rumour that it will not be very greatly below the April price, in which case blast-furnace owners will not start—at any rate, in the Derbyshire and Lincolnshire districts. It is possible that a few will start in Cleveland and in other districts, but one fears that the demand for pig iron at the prices which will be necessary will not be very great. The prospect of getting foundry iron prices down to £6 does not seem very bright at present, but there is a general belief that the foundry business cannot be better until pig iron can be had at £6 or less. Some few of the steel works are preparing to start, and this may mean a demand for basic iron; but in this connection it is worth noting that continental basic iron has been offered, delivered in Great Britain, at £5, and certainly our furnaces cannot make it at that price.

Finished Material.

There has been no change in the official prices for finished iron and steel, and they remain roughly at about £5 per ton above the continental prices. Of course, this state of things is absurd, and must be altered in some way if our trades are to recover. To-day there was practically no demand for finished material, but there was talk about foreign lots having been sold at about £9 to £9 15s. per ton.

Scrap.

There is nothing being done just now in the market for scrap, but dealers do not make any change in the prices they quote. Good cast scrap is held steadily for £6 5s. to £7 10s., according to quality, the latter being an extreme price for the best lots of textile scrap. Consumers, however, do not admit that they have paid such prices, and, of course, there is no buying yet. The prices for wrought and steel scrap are nominal. The Lancashire ironworks will still take in wrought scrap at £3, but that is all they allow, in spite of their price of £16 for bars.

Manchester Association of Engineers.

On Thursday, the 30th ult., at the invitation of the chairman—Mr. W. C. Bacon—and directors of the Manchester Ship Canal Company, some 200 members of the Manchester Association of Engineers had the privilege of viewing the Canal from Manchester to Liverpool. The party was conveyed along the Canal by steamer, and special opportunities were given during the journey of inspecting the large storage warehouses, a new 60-ton floating crane, just installed, and the new Stanlow oil dock, which is in course of construction. Luncheon was served on the lawn of the famous Bridgewater House, which was the residence of the first Duke of Bridgewater. Subsequently, Mr. Bacon expressed his pleasure at seeing such a large number of representative engineers present. The President of the Association—Mr. F. J. West—replied. On the motion of Mr. H. Pilling, ex-President, a hearty vote of thanks was accorded to the chairman and directors of the Canal Company for the courtesy and hospitality shown to the visitors.

Manchester Tramways.

In the annual report of the Tramways Committee of the Manchester Corporation, it is stated that for the first time since 1902 there had been no contribution towards relief of the city rates. In 1902 the contribution amounted to £20,000, by 1910 it had steadily increased to £75,000, and by the year ended with March, 1920, to £111,891. In those nineteen years the total amount saved to the ratepayers was £1,438,872. In 1902 the track in use was a little over 20 miles in length; in 1920, it was over 195 miles long. And in the same period the number of passengers carried rose from 23½ millions to over 285 millions. The parcels carried in 1907 numbered 141,715, and 1,111,332 in 1920. By last March the length of track had increased to nearly 200 miles, but 7,000,000 passengers fewer were carried than in 1920, and 1715 fewer parcels. The revenue produced amounted to £1,813,401, as compared with £1,586,863 in the preceding year, and the working expenses to £1,507,566, as against £1,207,230, leaving a gross profit of £305,834, as compared with one of £379,632 in the year ended with March, 1920. Of the balance of £124,428 left after meeting other charges, £106,165 is set aside for renewals and the rest for income tax.

BARROW-IN-FURNESS, Thursday.

Hematites.

There is naturally a better feeling in the hematite pig iron trade of this district, consequent on the re-opening of the mines and the supply of fuel which will follow. But as to when there will be any improvement in the iron trade with regard to business is not certain. Requirements are known to be heavy, but in order to secure new business, smelters will have to be in a position to quote much lower rates than has been the case for some time. Fuel will to some extent be cheaper, but the cut will not reach the price demanded by users of coal and coke, who speak of requiring coal in the region of 20s. per ton delivered, and coke not more than 36s. delivered, before things can become normal again. The settlement of the coal trouble, however, is the first step towards a general reduction in prices, and it should have its due effect. The autumn is mentioned as a likely period for a resumption on a fair scale, but some furnaces will, it is expected, be operating in August.

Iron Ore.

The mines remain idle. Any renewal of activity will soon be felt at the pits where no stores of ore are held. The stock of foreign ore on the Barrow docks, however, is considerable. The new price of native ore will doubtless show a cut.

Steel.

The steel trade is in the same position as the iron trade. Here there will have to be considerable cuts in prices if the competition from the Continent is to be met. Local foundries are working short time, and hoops have recently been rolled.

SHEFFIELD.

(From our own Correspondent.)

Back to the Pits.

MONDAY morning found the miners in the coalfields of Yorkshire, Nottinghamshire, and Derbyshire full of eagerness to re-commence work, but in almost every instance it was found they would have to possess their souls in patience for some little time before anything like a full resumption could take place. The fact was the men's anxiety during the strike to keep everybody out of the pits had reacted against them, for instead of the mines being in a state of preparedness, much work remained to be done before the roads and working places could be reported as safe for the men. At some of the collieries it may be a few weeks before normal working can be resumed, but for the sake of the output every effort is being made to hasten the moment when production will be full and regular again. In a few cases there is a fear that pits may never be re-opened; but time will show. Unfortunately, a dispute has arisen at the Staveley Company's pits regarding the question whether forks or shovels shall be used by the miner. The significance of the point is obvious, and from all accounts the company is determined that forks shall be used. The men asked that, in the event of their agreement with the owners on the point, they should receive something extra on the getting price, but the reply was that the men had their price lists, which would be adhered to. There, at the moment of writing, the matter stands, the owners being determined to keep the pits closed until the men agree to return on the terms indicated. It is a serious matter, for about 10,000 men are affected. However, it is hoped that a way out of the difficulty will be found and working speedily resumed. In the meantime the greatest satisfaction has been generally expressed by the men that at last they can get to work below once more. Here and there minor disputes hindered immediate resumption, but as a rule they were not of a serious char-

acter, and in certain instances it seems improbable that work will ever be resumed—in fact, dismantling is said to have commenced.

Missionary Work Wanted.

Sir William Ellis, one of the managing directors of John Brown and Co. and chairman of Davy Brothers, in addressing the shareholders of the latter concern on Monday, expressed himself in a way that should be read and pondered by everyone interested in industrial recovery, and especially by the workers. Sir William is not one of the men who are constantly in print, and what he says may always be taken as the result of thoughtful consideration of a question from all points of view. After alluding to the difficult times through which industrial concerns are passing, more especially as they may be affected by labour disputes and unrest, Sir William mentioned the prominent part he had taken of late in endeavouring to maintain peace in the engineering industry, and emphasised the continuous need, first and last, of patience and discretion in dealing with wages questions and allied topics. There did not exist among engineering employers, he said, any other desire in seeking to obtain reductions in wages than that of reducing production costs, for the direct reason that the high costs at present prevailing constituted an absolute bar to further orders being obtained. The statement reminded me of the fact that not very long ago the head of one of the leading steel firms asked me to preach, in season and out of season, the gospel that the employers were no parties whatever to any scheme to bring about a reduction in wages. It was the pressure of economic forces that compelled deflation of everything, including wages, and it was vain to set up serious opposition to what, after all, was inevitable. And now Sir William Ellis was speaking in precisely the same strain. Missionary work, he declared, was required to explain to workmen that in the economic conditions that obtained to-day it was absolutely impossible to secure work in competition with foreign suppliers unless our production costs could be brought down to a competitive level. The choice, he added, really lay between somewhat lower wages or no wages at all. The purchasing power of Europe, one might add, must some day recover itself, and when it does any temporary decline in wages to-day should then be restored, and the path to that restoration lies through greatly increased production of every class of manufacture. There is no doubt that this is one of the points which are coming to be very thoroughly understood, not, perhaps, by the man in the street, but certainly by the man in the works.

A "Noisy Minority" Turned Down.

Judging by the result of a meeting of Sheffield engineers on Sunday afternoon, one might have imagined a break with the employers to be inevitable. But "things are not what they seem." The meeting was run by a parcel of extremists, who managed to pass a resolution to the effect that the employers' terms be "thoroughly and overwhelmingly opposed," but before the ink in which the resolution had been written was dry the whole proceedings had been repudiated by the union officials. "These were the extreme men," explained one official, "many of them having no real connection with trade unionism and not much association with work. They do not represent the unions concerned. We are advising our men to accept the terms of the ballot, and I think the great majority of them will do so." Another declared that the meeting was composed of the noisy minority—men who always do the shouting—and added: "I think our members will vote for acceptance of the terms; I hope they will, because they are fair and reasonable." All of which puts a different complexion on the situation. The fact is that ballot papers were distributed in the Sheffield area on Monday and Tuesday, and it was expected that voting would take place practically all the week. The General Council, in accordance with agreement, recommended the districts to accept the employers' terms of settlement, and there seems every reason to believe the men will take that course. It is sincerely to be hoped that by the time this appears in print the engineers will have recorded their decision to accept the terms offered, so that, with the return of fuel to the market, the business of the country may be proceeded with. A good many firms of old standing have felt the strain of the last few months very severely indeed, and some have almost reached the breaking point, so that an engineers' strike, just as peace in the coalfields had been restored, would have been a most disastrous occurrence. If the industrial position is to be saved at all it can only be by sound co-operation between capital and labour.

Quick Loading of a Motor Lorry.

There have been in operation for very many years, of course, methods of lifting, by cranes, tray loads of goods from warehouse floors or railway trucks on to empty motor or horse lorries and *vice versâ*, but I have often heard the complaint at steel works that the employment of motor lorries, which usually require to be loaded and unloaded by hand, is not economical for short journeys. This fact made me wonder, when in the goods station of the London and North-Western Railway here a few days ago, whether a system which that company has in operation would be of service to iron, steel, and engineering firms with large loads constantly entering and leaving their works. It is not exactly new, for the North-Western, I understand, has had it in operation for about eighteen months; but the idea may not be known to some firms to which it might be of use. A unit consists of a four-ton motor lorry, two specially constructed horse lorries, two "trays" and one horse. The chassis is supplied by one of the motor building firms and the North-Western builds up the cab and other body parts, including a tray floor fitted with eight small wheels with ball bearings. The motor lorry, say, brings into the goods yard a four-ton load. Immediately on arrival it is backed against one of its horse lorries and with very little exertion a man rolls the tray load on to the horse lorry, which is at once backed against a railway wagon and unloaded. Meanwhile the motor has received a loaded tray from its other lorry and has departed within five minutes of arrival. The horse lorries which I saw were without springs, so as to preserve rigidity for the transit of the trays, and were old vehicles reconstructed. The idea was the invention of one of the company's staff at Crewe, but I understand it is not patented, so that apparently any large firm to which the idea commended itself might adopt it. The record for the North-Western's goods station here is eleven journeys, with about a four-ton load each journey, in eight and a-half hours by one motor lorry, the petrol ration for that period being six gallons.

Wanted—A Fuel Oil Central Depot.

Regarding the general trade situation, I continue to observe indications pointing to the hope of a fairly rapid recovery from the worst, though it is to be feared that no very substantial improvement must be looked for until the autumn. At the best of times the summer months are a little bit off the map for active trade, but as fuel supplies become available some of the firms with good orders on their books—and there are still a few of them to be found—will be able to get ahead; but I cannot see that the use of liquid fuel has received very much encouragement. There are those here who believe that many of the oil burners with which furnaces at a number of the works—including the gas company's works—have been equipped, will be retained permanently; but if so, something surely should be done in the way of providing centrally situated oil tank depôts. There is excellent provision for the central storage of petrol and lamp oil, and a few days ago I had an opportunity of inspecting it; but every ton of fuel oil consumed in the Sheffield area has to be brought into the city by tank wagons or in barrels from the coast. One of the large steel firms quite recently was rounding up all the tank wagons it could secure from anywhere in order to bring in a supply of fuel from Hull, and the small consumer, of course, is simply at the mercy of any middleman. Is not this a matter which ought to be taken up seriously? If Sheffield had had such a centre of supply when the coal strike commenced many works which have been idle for weeks need never have stopped. One of the features since my previous letter has been a rumour that William Jessop and Sons, which is now controlled by the Birmingham Small Arms, was about to close down indefinitely, but the chairman, Mr. A. J. Hobson, who was approached on the matter, gave a prompt denial of the story. He added, however, that the firm was making further reductions because there "was no hope of a real resumption of trade until the price of coal reached an economic level." On the other hand, I learn that representatives of Sheffield firms making cutting and other parts of agricultural machinery and implements did quite a nice lot of business at the "Royal" last week, where I was very pleased to note the enterprise of the whole list of Lincolnshire engineers. If our agriculturists are not up to date it certainly is not the fault of our engineers, who are thoroughly prepared for a revival in the home and overseas markets. Davy Brothers have recently obtained an order from a prominent firm of tube makers in this country for a continuous Morgan "skelp" mill, for executing which the company's new works at Darnall are, Mr. A. J. Capron, the managing director, says, particularly well placed. In other directions the trade position shows little change.

NORTH OF ENGLAND.

(From our own Correspondent.)

What of the Future?

Now that the troubles of the industrial world are being smoothed over with honourable peace both to the mineowners and the miners, and an amicable agreement is likely to be reached in regard to the engineers' wages reduction, all sections, whether they be employer, employed, or consumer, have their attention riveted on the future and what it has in store for them. They will gladly forget the nightmare of the past three months, and think only of trying to repair—if that is possible, and time will tell—the great injury that has been done to British commerce, not only at home, but in the far corners of the world. And what of the future? True it is that industrial peace has been restored, but if anything, it has brought greater anxieties than perhaps prevailed during the coal dispute. It is with difficulty that one can present an exact perspective at present of the general outlook so far as the North of England is concerned. To be frank, the industrial position seems to be in the melting pot. It has so many elements of uncertainty that not even the most optimistic of the great employers of labour on the banks of the Tyne, Tees and Wear, or the colliery owners of Northumberland and Durham can permit themselves to speak with encouragement of the days that are to come. Everyone realises that the disastrous state of affairs caused by the mining dispute to every industry will take time to straighten out, but the length of time it will take depends largely upon the determination and the spirit of goodwill of all concerned to see that things are righted with the least possible delay. Of course, it cannot be expected that the wheels of industry will be set in motion with magician-like rapidity, as there are many things to be considered. Within a month, however, one will be able to see how matters are developing. Hopes are entertained that the great industrial centres will by then be shaping themselves into something like their usual activity.

Slow Absorption of Labour.

Already preparations are being made to re-start some of the works, but the general belief is that the absorption of the displaced labour in the iron and steel trades will be a slow business. The position of manufacturers is fraught with difficulties, and they quite naturally want to be sure of their ground before again resuming operations. At present it is impossible to give a hint when the blast-furnaces as a whole will be set going, for there are several factors to be considered, one of the chief being the question of production costs. This is a matter of serious concern to employers, who cannot afford to drop the large sums of money through the fall in prices, such as was their unfortunate lot before the miners' dispute. Facts cannot be blinked at. Sir Arthur Pease only recently gave a telling example of how £50,000 had been lost by the firm with which he is prominently identified through the fall in value of Cleveland iron. With such market uncertainties manufacturers will watch events cautiously. Still, it is probable that a few blast-furnaces will be put on for the production of basic iron required by the steel firms for their own particular use, but there is no suggestion as yet of any work being begun for the output of Cleveland foundry pig iron for the open market.

Cleveland Iron Trade.

There is an entire lack of optimism in the Cleveland iron trade, and the whole outlook appears to depend upon the cost of fuel. Manufacturers are likely to move slowly. Some colliery owners are quoting more for coal than before the dispute, and others are asking the same price as ruled the market before April. If this attitude is maintained manufacturers will find their position as to the future greatly handicapped, for they cannot afford to buy fuel at the present price and compete with foreign markets. Ironmasters are in no particular hurry to re-start their furnaces, but a number of steel firms which are anxious to get their mills going again are preparing to start rolling without waiting for the blast-furnaces. Nothing definite can be gleaned as to the re-starting of the blast-furnaces, but an effort is to be made to get several going at the earliest possible moment. Stocks of foundry iron are about exhausted, and realising that for some time ahead no more will be available in Cleveland, holders are hardening the price. It is made a condition that purchasers of No. 3 Cleveland G.M.B. must take an equal parcel of No. 4 foundry iron at an overhead price of 135s. per ton, but that is only the home price for July. For August £7 per ton is asked, whilst in both instances 5s. per ton extra is demanded for export. Supplies of forge, mottled and white iron are plentiful, and though the prices are reasonable there is very little trade passing. No. 4 forge and mottled iron are 117s. 6d. per ton, and white iron is at 115s.

Hematite Pig Iron.

There is a prospect of an early revival of inquiries for East Coast hematite pig iron. There have already been feelers. Manufacturers continue to demand 160s. for mixed numbers, and 162s. 6d. per ton for No. 1 to home buyers, while 140s. is generally the figure asked for export.

Manufactured Iron and Steel.

In the manufactured iron and steel trade business is quiet, and the recent cuts in prices have not as yet brought the desired results. Work is to be resumed with every possible haste in the steel mills, as manufacturers want to wipe off the arrears of deliveries both to home and foreign consumers. A reduction has been made of 20s. per ton in heavy steel rails and fish-plates, the ruling prices respectively now being £14 and £19.

Coal Trade Position.

The future of the coal trade in Northumberland and Durham is giving concern to all who are interested, and the miners will be the first to realise how easy it is to upset organised industry and how difficult it is to restore it to anything like its normal aspect after a prolonged stoppage. They were quick enough to throw their bread and butter to the four winds, but now that they are anxious to earn their livelihood again fate has decreed that it can only be done by a slow process. Work in the mines cannot be found for all the men who are anxious to start, and it is probable that hundreds of men will have to seek "fields and pastures" new, because the pits they formerly worked at are so out of order that they cannot be safely worked, while in other instances colliery owners cannot see their way to make things pay. The outlook for many miners is still serious. It is stated on good authority that one of the most up-to-date collieries in Durham County—Blackhall—is not to be reopened in consequence of the high cost of production, and the loss the owners, the Horden Collieries, Limited, had sustained. This will mean that 1500 miners will still be unemployed. The same state of affairs is applicable to other pits in both counties. As in other industries, the absorption of mining labour will be slow, and three weeks may elapse before employment has reached anything like its normal. The men have early shown their desire to get into harness, and that willingness may help matters along a great deal. It is also of interest to note that the Durham miners have decided to abandon their annual gala this month, which means that instead of playing over a week end they will be hard at work. In regard to the state of the coal market, the position is full of possibilities, and, of course, chief concern is directed towards home needs, the supplying of coal for public utility concerns and industries. The export situation is somewhat obscure, but there are signs of an early resumption of this branch of the trade. Numerous inquiries are floating round, but colliery proprietors are not in a position to guarantee delivery with any degree of confidence, and in the majority of cases are disinclined to consider actual business for the first two months. Further forward there is nothing definite attempted. It is even hinted that, when the rush is over, there will be a fall in values. The current values remain unaltered.

Wear Shipbuilding.

The shipbuilding slump on the river Wear is evidenced by the fact that only one vessel of 9475 tons was launched last month. For the six months of this year only thirteen boats, with an aggregate tonnage of 70,902, have been launched, compared with thirty-five vessels and a total tonnage of 160,263 for the corresponding period of last year.

Wages in Ironworks.

Representatives of organisations of employers in the iron and steel trades, and of the National Union of General Workers and the National Amalgamated Union of Labour, have recently been in conference over the question of wages, and it is understood that the result of the deliberations was full of promise for the establishment of industrial peace. Agreements were reached with respect to wages and conditions, and it was announced that

arrangements were in view by which machinery would be set up for the avoidance of future disputes and to stabilise industrial peace by the adoption of a principle of arbitration acceptable to both sides. During the months of July, August and September, Consett steel millmen's wages will be 35 per cent. below the wages prevailing during the three previous months, but 155 per cent. above the standard.

Disastrous Half-year.

The official June figures for the value of the export trade in the Cleveland iron and steel industries speak for themselves. They are eloquent facts of the havoc wrought by the industrial upheaval. In the first half of 1920, 407,539 tons of pig iron, manufactured iron and steel were exported from the river Tees, but for the six months of this year the total was only 185,443 tons, comprising 55,545 tons of pig iron and 129,898 tons of manufactured iron and steel. The exports for last month were 10,197 tons of pig iron and 5615 tons of manufactured iron and steel. It is interesting to record that Belgium and France still continue to be the principal buyers of pig iron, taking in all 6197 tons during the month. The position of the manufactured steel exports is one that requires serious reflection, as that class of trade has been hampered considerably. The Indian demand, usually in the region of 10,000 to 15,000 tons, simmered down last month to under one-tenth of those figures, while Japan was only supplied with a small parcel of 66 tons. It will thus be seen that there is a great deal of lost ground to be made up. A return of imports to Stockton and Middlesbrough of iron and steel from Holland, Belgium and France during the past eight months has been published by the Tees Conservancy Commissioners. The amount of plates, bars, angles, rails, sheets, joists, &c., imported during June was 1622 tons, or 16,641 for the past eight months, as against an aggregate of 17,419 tons in 1913–14, and 17,508 in 1912–13.

SCOTLAND.

(From our own Correspondent.)

Counting the Cost.

PEACE in the coal trade is an accomplished fact at last, and the process of counting the cost has commenced. The results of the pit flooding will be in evidence for many months yet, and the ultimate cost must be enormous. The damage to Scottish pits alone is estimated at £2,000,000. It is computed that the damage in Fifeshire will amount to half of the total. This damage is, of course, attributable to the action of the miners' leaders in withdrawing the safety men from the pits, but to the owners will fall the expense of putting things in order again. Practical opinion states that in some of the great collieries an expenditure of from £50,000 to £100,000 will be required to restore normal conditions. In the light of these figures, therefore, it is not surprising to learn that certain pits in all the districts have been abandoned. The immediate effect has been to curtail employment to an enormous extent, and a much reduced output will be the natural sequel. Many miners must necessarily be unemployed for months, while some may never regain work in their own districts. Further, instead of a reduction in the price of the product, the result is more likely to prove the opposite. Immediate rumours at least point to substantial increases over pre-strike quotations.

The Point Gained.

The point gained by the men—namely, the sharing in profits—has created great satisfaction. It is undoubtedly an important concession, and the gathering of the fruit means gain to all and loss to none, and the bigger the harvest the better for all. Thus an important principle has been established, which, after all, is really a guarantee of payment by results.

Shipbuilding.

Nothing else than a steady decline in output could be looked for under present conditions, and viewed in that light the returns for June must be considered satisfactory. The Clyde returns for June show a total of sixteen vessels of 40,371 tons aggregate as compared with eighteen vessels of 42,249 tons in June, 1920. Last month's total is largely explained, however, by the fact that one steamer accounted for about one-third of the total. The principal launches were :—The Largs Bay, t.s. geared turbine, 13,500 tons, for the Commonwealth Government Line of Steamers, Australia ; Tjikandi, geared turbine, 8000 tons, for the Java-China-Japan Line ; Chilka, geared turbine, 4150 tons, for the British India Steam Navigation Company, Limited ; and the Santa Cruz, oil tank steamer, 3950 tons, for the Argentine Government. The output for July is almost certain to be of a very small tonnage. Instead of the usual ten days' holiday the yards will be closed for three weeks, and very little work can be done before the closure. A fair amount of work is still on hand, but new contracts are very slow in coming forward. The totals for the first six months show a decrease of over 51,000 tons compared with last year, and 112,680 tons below the record in the same period in 1913. This year's total to date is ninth on the list. It seems inevitable that a large decrease must be looked for at the close of 1921. The reductions in materials and wages and the close of the coal strike would have a more pronounced effect on the trade if the chance of labour troubles in the shipyards was eliminated and the price obtainable for new tonnage was to improve.

Steel, Iron and Coal.

With the approach of the holiday season there is not likely to be much movement in the steel and iron trades before the month of August. Holidays are longer this year, and in any case there appears little likelihood of cheaper coal for some time. Prices of both steel and iron require to fall some distance yet before orders can be looked for with any confidence. There is no sign yet of a re-starting of the pig iron furnaces. Makers say that smelting fuel is still too dear. Stocks of foundry pig-iron are very far reduced, but makers have fair holdings of hematite, for which they are quoting £9 per ton. Continental basic pig iron is quoted delivered in this district at £5 3s. 6d. There has not been much doing in the coal market so far. Supplies are not available yet, while firm quotations are hardly obtainable. It has been reported that some qualities of industrial coal are quoted 4s. above pre-strike prices, while as much as 7s. 6d. to 10s. per ton additional has been asked for other qualities. House coal has been selling at 4s. per bag, but the quality is most inferior. A little more shipping inquiry is reported, but negotiations are yet almost unknown.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

After Strike Troubles.

WORK was resumed in the South Wales coalfield on Monday, but the district is not entirely free from trouble. As a matter of fact, this trouble might easily have been on a larger scale when it is considered that the South Wales delegate conference, which met on Thursday of last week, decided, by a majority of only three, to adopt the recommendation of the Executive Council to ratify the agreement which had been entered into between the miners' representatives and the Government and coalowners. The voting was 112 to 109, which shows that the miners were pretty evenly balanced. It is scarcely surprising, therefore, that there are still murmurs of disapproval of the conditions, and this is not likely to be helped by the attitude of certain extremists, who, in an article by Mr. Frank Hodges, the general secretary of the Miners' Federation of Great Britain, are the object of a fierce attack. Mr. Hodges, who defends the Miners' Federation, severely criticises men of the advanced type, whom he accuses of being responsible for prolonging the stoppage and for much of the misery which has been and is yet to be endured by the miners. He states that "the lot of the South Wales miner will not be a happy one for a long time to come, especially if the workmen continue to put their trust in these anti-leaders, whose principal pursuit in life has hitherto been to step into the leaders' shoes out of due time." It is scarcely conceivable that the article of Mr. Hodges will be taken quietly, and there are already rumours that South Wales is by no means likely to be free from discord in the near future. In several areas in South Wales resolutions were passed condemning the settlement, although the responsible leaders have endeavoured to put the best construction possible on the terms, which provide for a drop in wages of only 2s. per day instead of 11s. 7d., which would have been the case if they had accepted the situation as it stood at the end of last March. The majority of miners made a start on Monday, but a notable exception was that at the Ebbw Vale Collieries, where the owners have stipulated for terms which are entirely unacceptable to the workmen, according to whom the men were asked to go back to work, not on the 1914 standard, as elsewhere, but on a price list arranged in Ebbw Vale forty years ago. Negotiations, however, are proceeding, and hopes are entertained that the trouble will be smoothed over. A hitch also occurred in the case of the Tower Colliery of the Duffryn Aberdare Colliery Company at Hirwain. In this case the management intimated to the Joint Committee that it was the intention not to re-open the colliery until the workmen dispensed with the services of a checkweigher and minimum wage agent, but as the result of an interview with Mr. D. R. Llewellyn concerning charges which had been brought by the latter against the agent in question, an arrangement has been come to whereby the men agreed to resume work without the services of the agent, and the points complained of are to be referred to the Conciliation Board for decision. With these exceptions, the re-start of work in the coalfield has been fairly satisfactory, as the percentage of men who resumed ranged from about 55 per cent. to 75 per cent. At the same time, most of the work has been in the repairing line, and, so far, comparatively little coal has been produced, but it is fully expected that by next week supplies will be on a fairly active scale, and the conditions will be well on the way towards becoming normal. Of course, at some of the collieries, the amount of repair work necessary after such a long stoppage is very considerable and will take weeks, while in a few instances it is not expected that the pits will reach their full productive capacity for months to come.

Commercial Activity.

All things considered, operations on the commercial side have turned out much more satisfactory than was at one time expected, in view of the keen competition from American and other coals. Of course, the amount of business in view has to be considered in relation to the quantity of coals available, and when looked at from this point of view, the demand is pretty good. At the same time, many buyers abroad are, for the moment only testing the market, and prefer to adopt a waiting policy in the full belief that there will be a reduction in values when the market settles down. Orders now in hand are principally for early shipment, i.e., for shipment within about three weeks or a month from the time of the resumption of work. Owing to the uncertainty as to the actual quantity of coals available, and the extent of the demands inland, the bulk of the collieries have, so far, refused to give any guarantee as to date within which shipments can be made, and have confined themselves solely to undertaking to ship as quickly as possible. On the other hand, coal exporters, who are really the backbone of the export business, have, as usual, shown themselves ready to take risks, and by undertaking to effect shipments within a comparatively short period, have thus been able to secure prompt orders. The question whether the flow of orders will continue is a very open one. It may be that when these are executed, buyers, having satisfied their most pressing requirements, may prefer to hold off for lower prices as the belief still prevails that the values of South Wales coals must come down still further before this district is on a firm footing for competing with foreign coals. What the conditions will be after this month it is very difficult to say. For one thing, now that business has returned to such an extent to pre-war conditions, and is conducted so extensively on a c.i.f. basis, it naturally follows that the question as to rate of freight enters very largely into the calculations of coal exporters. Already quotations for business abroad are cut to the very finest margin, and it may be that in the course of the next month or two tonnage will become much more distributed and rates of freight from this district may possibly improve. Any material improvement would certainly upset the calculations of exporters, and minimise their prospects of securing buiness. The demand for tonnage, at the moment is very largely for handy-sized boats, inasmuch as the orders from abroad are restricted in size, and, furthermore, it is easier to get smaller vessels loaded and sailed in view of the curtailed outputs.

Coal Prices.

Undoubtedly a fairly considerable amount of coal will be required inland for the next month or two, and this being the case, the quantity available for export will be limited. Already many collieries have quite as much business on their books as they can entertain for this month's shipment, and consequently prices remain very steady. Best Admiralty large is firmly quoted at 45s. to 47s. 6d., with ordinary Admiralties at 45s. Monmouthshire coals are even firmer than other descriptions, for the reason that the demand inland for them is expected to be relatively heavier on account of railway and general industrial requirements. Superior Monmouthshire large coals are quoted at as much as 50s. In the case of smalls, best steam smalls range from 22s. 6d. to 25s., with inferior qualities from 15s. to 20s. Patent fuel meets with a fairly good inquiry owing to the fact that many buyers abroad fully expect to be able to secure this commodity with more certainty than some of the steam coals. The price of patent fuel ranges from 40s. to 45s. Pitwood commands about 40s.

The Railways Bill.

The Cardiff Shipowners' Association has elected three of its members to co-operate with the Parliamentary Sub-committee of the Cardiff Corporation in securing amendments in the Railway Bill. In a letter to Sir Eric Geddes, the latter's attention is drawn to the fact that under Clause 12, the Railway and Canal Commission were empowered to make orders compelling railway companies to spend money for securing and promoting the trade of any particular district not exceeding £100,000. This limit the Association regard as absolutely inadequate, and Sir Eric Geddes has promised to strengthen the clause in Committee.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Coal Prices and Idle Pits.

THE Staffordshire and Warwickshire coalowners have this week decided that coal prices shall remain as ruling from March last, without any advance. The pits in South Staffordshire remain idle, the owners declining to continue special conditions secured to the enginemen and underground firemen by an agreement which expired in April. The masters state that these were war-time measures which have now lapsed, "and that they cannot be expected to pay for time not worked or duties not performed."

WALES AND ADJOINING COUNTIES.

Colliery Dispute.

The miners employed at Nine Mile Point colliery have not resumed work. It is stated that the employers have laid down conditions, which mean an attack upon customs which have been in operation since the colliery was sunk.

Swansea Metal Exchange.

Business is very quiet, and is checked by the uncertainty regarding supplies of coal and future prices. It is scarcely expected that the tin-plate industry will show signs of a real revival for some months. Tin bars must also come below their present official minimum of £10 10s., which is considerably above the price of foreign supplies.

Steel Works Restart.

The Port Talbot Steel Works furnaces were relighted on Wednesday, and hopes are entertained that operations will be resumed in the mills and other departments next week. The works normally employ about 2000 hands.

CATALOGUES.

HOWARD T. WRIGHT, 161, New Bond-street, W. 1.—Pamphlet under the title of "The Business Doctor."

ENGINEERING AND COLLIERY APPLIANCES, Limited, Sheffield. —Pamphlet dealing with "Ecal" hack saw blades.

BRADY AND CO., Limited, Glasgow.—Illustrated catalogue dealing with high-grade steel casements. The different designs are illustrated and may be supplied either in steel or gun-metal.

A TURRET LATHE WITH GUARDED HEADSTOCK.—In our issue of last week we inadvertently stated in our description of Alfred Herbert's turret lathe that the spindle and all the shafts in the headstock ran on ball bearings. While all the shafts run in ball bearings, the spindle runs on white metal encased by cast iron shells.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	49/- to 60/-
[1] Spanish	30/-
[1] N. African	30/-
N.E. COAST—	
Native	—
Foreign (*c.i.f.*)	37/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—[2]		
Hematite	9 0 0	—
No. 1 Foundry	8 10 0	—
No. 3 ,,	8 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	8 0 0	7 0 0
No. 1	8 2 6	7 12 6
Cleveland—		
No. 1	6 15 0	7 0 0
Silicious Iron	6 15 0	7 0 0
No. 3 G.M.B.	6 15 0	7 0 0
No. 4 Foundry	6 15 0	6 5 0
No. 4 Forge	5 17 6	5 17 6
Mottled	5 17 6	5 17 6
White	5 15 0	5 15 0
MIDLANDS.		
Staffs.—		
All-mine (Cold Blast)	17 0 0 to 17 7 6	
Part Mine Forge	8 0 0	
,, Foundry No. 3	9 0 0 to 9 5 0	
Northampton [2]—		
Foundry Nos. 2 and 1	8 10 0	
,, No. 3	8 5 0 to 8 10 0	
,, Forge	6 17 6	
Derbyshire [3] (*All nominal*).—		
No. 3 Foundry	8 15 0 to 9 0 0	
Forge	7 0 0	
Lincolnshire [3]—		
Basic	*Uncertain.*	
Foundry	,,	—*some sold at £8*
Forge	,,	
N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	8 0 0	
Special	9 0 0 to 11 0 0	

MANUFACTURED IRON

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	16 0 0	25 0 0
Best ,,	31 0 0	—
Angles	30 0 0	—
Tees	31 0 0	—
N.E. COAST—		
Crown Bars	16 0 0	19 0 0
Best ,,	17 0 0	20 0 0
Angles	30 15 0	30 15 0
Tees	31 10 0	31 10 0
LANCS.—		
Crown Bars	16 0 0	—
Hoops	20 5 0	20 0 0
S. YORKS.—		
Crown Bars	16 0 0	—
Best ,,	17 0 0	—
Hoops	20 5 0	—
MIDLANDS—		
Marked Bars (Staffs.)	22 0 0	—
Crown Bars	16 0 0	—
Nut and Bolt Bars	16 0 0	—
Black Sheets, (dbls.)	18 0 0 to 20 0 0	
Galv. Sheets, 24 W.G. (f.o.b. L'pool, or equal	24 0 0 to 26 0 0	
Gas Tube Strip	20 0 0	—

STEEL.

	Home.[5] £ s. d.	Export.[6] £ s. d.
SCOTLAND—[4]		
Boiler Plates	20 0 0	24 0 0
Ship Plates ⅜in. and up	15 0 0	—
Sections	14 10 0	—
Steel Sheets ⅛in. to ⅜in.	16 5 0	—
Sheets (Gal. Cor. 24 B.G.)	—	26 0 0

STEEL (*continued*)

	Home. £ s. d.	Export. £ s. d.
N.E. COAST		
Ship Plates	15 0 0	15 0 0
Angles	14 10 0	14 10 0
Boiler Plates	21 0 0	21 0 0
Joists	14 10 0	14 10 0
Heavy Rails	14 0 0	—
Fish-plates	19 0 0	—
Channels	20 0 0	—
Hard Billets	15 0 0	—
Medium Billets	14 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	14 0 0	—
Light ,,	17 0 0 to 19 0 0	
Billets	10 0 0	—
Ship Plates	15 0 0	—
Boiler ,,	21 0 0	—
MANCHESTER (*Prices irregular and uncertain, unchanged*)—		
[7] Bars (Round)	14 0 0 to 16 0 0	
[7] ,, (others)	15 0 0 to 16 10 0	
Hoops (Best)	20 5 0	20 0 0
,, (Soft Steel)	17 5 0	17 0 0
Plates	15 0 0	—
,, (Lancs. Boiler)	21 0 0	—
SHEFFIELD (*Prices irregular and uncertain*)—		
Siemens Acid Billets	20 0 0	—
Bessemer Billets	19 10 0	—
Hard Basic	15 0 0	—
Soft ,,	14 0 0	—
Hoops	17 5 0	—
MIDLANDS—		
Small Rolled Bars	13 10 0 to 15 0 0	
Soft Billets and Bars	12 0 0 to 13 0 0	
Hoops	18 10 0 to 20 0 0	
Tube Strip	17 0 0 to 18 0 0	
Angles and Joists	14 10 0	—
Tees	15 10 0	—
Bridge and Tank Plates	15 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	25/6 to 28/-
Block Tin (cash)	172 5 0
,, (three months)	174 5 0
Copper (cash)	72 5 0
,, (three months)	72 5 0
Spanish Lead (cash)	23 5 0
,, (three months)	23 5 0
Spelter (cash)	26 7 6
,, (three months)	27 2 6
MANCHESTER—	
[8] Copper, Best Selected Ingots	73 10 0
,, Electrolytic	76 0 0
[9] ,, Strong Sheets	112 0 0
,, Loco Tubes	0 1 3½
Brass Loco Tubes	0 1 1¾
,, Condenser	0 1 5¾
Lead, English	24 15 0
,, Foreign	23 15 0

(*Metal prices practically unchanged*).

FERRO ALLOYS,

(*All prices now nominal*).

	Per Ton.	Per Unit
Tungsten Metal Powder	2/3 per lb.	
Ferro Tungsten	1/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£37	15/-
,, 6 p.c. to 8 p.c. ,,	£37	15/-
,, 8 p.c. to 10 p.c. ,,	£36 10 0	15/-
,, Specially Refined		
Max. 2 p.c. carbon	£86	32/-
,, 1 p.c. ,,	£102	39/-
,, 0·75 p.c. carbon	£120	47/-
,, carbon free	3/ per lb.	
Metallic Chromium	6/6 per lb.	
Ferro Manganese (per ton)	£25	
,, Silicon, 45 p.c. to 50 p.c.	£15 10 0 scale 8/6 per unit	
,, ,, 75 p.c.	£22, scale 12/- per unit	
,, Vanadium	22/- per lb.	
,, Molybdenum	7/9 per lb.	
Nickel (per ton)	£190	
Cobalt	15/- per lb.	
Aluminium (per ton)	£150	

FUELS *

SCOTLAND.	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	35/6 to 37/-
,, ,, Ell	37/6 to 38/6
,, ,, Splint	40/- to 50/-
,, ,, Trebles	36/6
,, ,, Doubles	33/-
,, ,, Singles	28/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	35/6
,, ,, Splint	40/-
,, ,, Trebles	32/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	35/- to 40/-
Screened Navigation	50/-
Trebles	36/6
Doubles	32/-
Singles	29/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	36/-
Secondary Steam	34/6
Trebles	32/-
Doubles	30/-
Singles	27/-
ENGLAND.	
[10] N.W. COAST—	
Steams	45/- to 49/-
Household	56/8 to 60/-
Coke	56/-
NORTHUMBERLAND— Home.	
Best Steams 42/6 to 45/-	—
Second Steams 40/-	—
Steam Smalls 13/- to 17/6	—
Unscreened 27/6 to 30/-	—
Household 36/- to 40/-	—
DURHAM—	
Best Gas 42/6 to 45/-	—
Second 35/- to 37/6	—
Household 36/- to 40/-	—
Foundry Coke 50/- to 55/-	—
Furnace 50/- to 55/-	—
SHEFFIELD—[11]	
S. Yorks. Best Steam Hards	33/2 to 33/8
Derbyshire Hards	32/8 to 33/2
Seconds	31/8 to 32/2
Cobbles	31/8 to 32/2
Nuts	31/2 to 32/2
Washed Smalls	28/8 to 30/2
Best Hard Slacks	20/- to 25/-
Seconds ,,	20/- to 23/-
Soft Nutty ,,	20/- to 25/-
Pea ,,	18/- to 22/-
Small ,,	15/- to 18/-
House, Branch	37/2 to 37/8
,, Best Silkstone	33/8 to 34/2
Blast Furnace Coke	(45/-, 55/- export)
[12] SOUTH WALES.	
CARDIFF—	
Steam Coals:	
Best Smokeless Large	45/- to 47/6
Second ,, ,,	45/- to 47,6
Best Dry Large	45/- to 47/6
Ordinary Dry Large[13]	42/6 to 45/-
Best Black Vein Large	47/6 to 50/-
Western Valley ,,	45/- to 47,6
Best Eastern Valley Large	45/- to 47,6
Ordinary ,, ,,	40,- to 45/-
Best Steam Smalls	22 6 to 25/-
Ordinary ,,	15/- to 20/-
Washed Nuts	40,- to 45/-
No. 3 Rhondda Large	47/6 to 50,-
,, ,, Smalls	35,- to 40/-
No. 2 ,, Large	40 - to 42,6
,, ,, Through	35/- to 37/6
,, ,, Smalls	17 6 to 22 6
Coke (export)	60/- to 65,-
Patent Fuel	42 6 to 45 -
Pitwood (ex ship)	37,6 to 42 6
SWANSEA—	
Anthracite Coals:	
Best Large	55/- to 60/-
Seconds	52/6 to 55/-
Red Vein	50/- to 52/6
Big Vein	50/- to 52,6
Machine-made Cobbles	65/- to 70,-
Nuts	65/- to 70/-
Beans	57/6 to 62,6
Peas	40/- to 45/-
Breaker Duff	15/- to 17/6
Rubbly Culm	25/- to 27/6
Steam Coals:	
Large	47/6 to 50/-
Seconds	40/- to 45/-
Smalls	17/6 to 22/6
Cargo Through	37/6 to 40/-

*** As a consequence of the mines dispute the markets are still in-active, but a few important changes in the price of fuels should be noted. The movements in the steel markets are particularly interesting.**

[1] Delivered. [2] Net Makers' works. [3] At furnaces. [4] Glasgow, Lanarkshire and Ayrshire. [5] Home Prices—All delivered Glasgow Station.
[6] Export Prices—F.O.B. Glasgow. [7] Prices represent the real market before the *official* change was made. [8] These prices are practically alike now.
[9] Sheets reduced while other prices are advancing. [10] Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. [11] For inland sales. [12] Per ton f.o.b. [13] Per ton f.o.b.

French Engineering Notes.

(From our Correspondent in Paris.)

Finance and Trade.

THE last few months have seen so many hopes of trade improvement disappointed that manufacturers are regarding the future with more and more misgiving. There is now a general impression that we have not yet seen the worst, and that all branches of industry will yet have to pass through some months of depression before there can be a turn for the better. An increasing number of works and factories are being closed down, and many people are profiting from the absence of business to take their holidays. There are several reasons to account for this state of things. The hopes of profiting from the reparation agreement have dwindled almost to vanishing point, and the amount already received under this head is insufficient even to cover the heavy sums the French Government has been advancing on account, with the result that the financial situation in the devastated regions is distinctly bad. The refusal of the United States to provide relief in respect of the Allied debts has also complicated matters, since the French find that they must now rely entirely upon themselves, as well as upon the payments of Germany extended over a considerable number of years. The only hope, therefore, lies in the successful issue of the loans that the various devastated towns and industrial syndicates have been authorised to issue. The colliery companies applied for public subscriptions recently with the guarantee of the State, and now it is the turn of the sugar manufacturers, who hope to reconstruct their factories with public capital; but it is doubtful whether much of this stock will be taken up outside Lille and other industrial exchanges, and it is difficult to see how the huge total represented by these issues can be absorbed.

Wages and Organisation.

While the situation is unsatisfactory there is still confidence in the future when the more pressing problems shall have been solved. There is work to be done as soon as the financial position permits of orders being given out, but this work will not alone keep all the factories fully employed, and it is felt that future prosperity depends upon a reorganisation of industry and upon a reduction of wages to allow of French manufacturers competing for the world's trade. Reconstruction has not proved a factor in industrial recovery, because orders have been distributed so far in small lots, and although a vast amount of work has still to be done there is nothing to show that we may expect a further distribution at an early date. The industrial policy of France has always been individualistic, with a leaning to Government support when things do not go satisfactorily; but now strong efforts are being made to bring about an industrial organisation with the idea of providing facilities for developing the export trade, reducing prime costs and, of course, bringing down wages. The wages problem is a particularly difficult one, and although there have been many cuts it is felt that if trade is to revive there must be a general scaling down of wages. This sentiment is, of course, assisted by the lack of employment, and if the present state of things should become aggravated wages may decline still further. Nevertheless, they must necessarily adjust themselves automatically to the cost of living, which, in its turn, depends largely upon the Government's fiscal policy; but so far the measures of protection being adopted for the sugar manufacturers and others do not point to any appreciable relief. The Government is still withholding its new minimum tariff, which is understood to be of a highly protectionist character, and in view of the strong recommendations put forward by the Chambers of Commerce and by the different commercial and industrial congresses it is probable that the Government may be brought to see the wisdom of adopting a sounder economical policy.

German Material.

Under present circumstances it is only natural that French manufacturers should protest against the negotiations being carried out with the German Government for the supply of 25,000 wooden houses and other material for the devastated regions. But such protests are scarcely logical in view of the fact that the French are unable to provide suitable houses at anything like reasonable prices or even within a reasonable time. Had the French Government entertained the offers of home manufacturers it would still be unable to give out orders through lack of funds, and for that reason the Minister of Reconstruction has been disposed to accept the German co-operation on a fairly large scale, the more so because it provides the only way of enabling Germany rapidly to liquidate a part of her debt. The sooner the work of reconstruction is undertaken the better it will be for the country generally, and for the moment it is not easy to see how such work can be done without German aid. There has been a good deal of agitation over an arrangement whereby the Germans are alleged to have been authorised to supply a considerable number of locomotives and other material. The Minister admits that the Germans have furnished some machines, but he denies having acquired large quantities to the detriment of French manufacturers. Monsieur Loucher refuses to regard the devastated regions as a closed market where home firms are permitted to impose any prices they please.

Railway Catastrophe.

The accident to the express train from Lille to Paris, in which about thirty people lost their lives and more than sixty were injured, appears to have been a sheer fatality. The train was crowded with passengers, and when near Beaumont Hamel, in what is known as the "red zone," on account of the fighting that took place there, the guard's van left the rails and fell down a shallow embankment, dragging with it two third-class coaches. The rest of the train remained on the rails. At first it was supposed that the line had warped on account of the heat, but while that explanation is not rejected as a contributory cause, the inquiry that was made immediately after the disaster suggests that there must have been some other reason besides disturbance of the permanent way.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

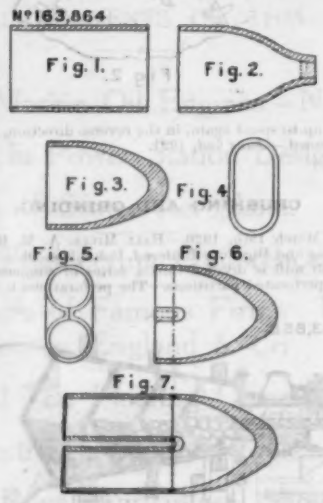
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

163,864. March 24th, 1920.—SUPERHEATER TUBES, Stewarts and Lloyds, Limited, 41, Oswald-street, Glasgow.

This specification describes a process for making the "spear head" junction pieces of locomotive superheater tubes. The illustrations show the various stages in rotation. The tubular blank is first pointed in a hydraulic staving machine and the

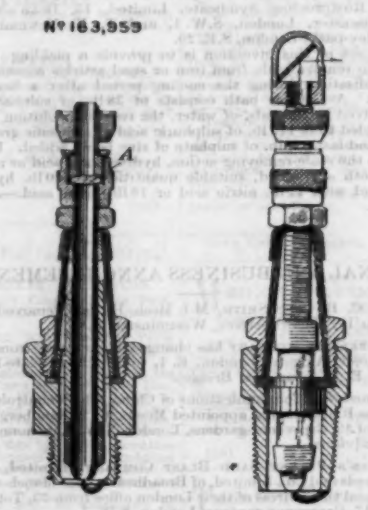


end closed with a plug. The end is then formed on a peg with a snap and the sides flattened. Finally the sides are pressed together at the centre, to form the two circular openings for the tubes, and welded by means of the oxy-acetylene blow-pipe.—*June 2nd*, 1921.

INTERNAL COMBUSTION ENGINES.

163,959. October 22nd, 1920.—SPARKING PLUGS, A. W. Armstrong, 47, Lissenden-mansions, Lissenden-gardens, N.W. 5.

In this sparking plug a hollow electrode is employed and a lens A arranged at the upper end so that the operation of the spark may be observed. The spark takes place between the point shown and the edge of a small opening at the bottom of

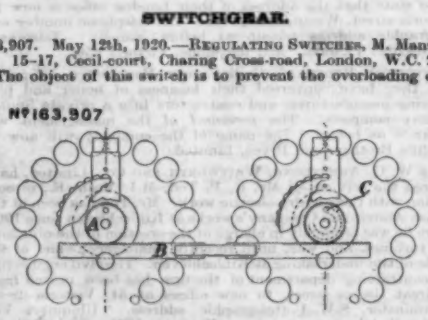


the electrode. The opening is made as small as is practicable to prevent, as far as possible, the lens being obscured by oil and fumes. In the modification shown on the right a small mirror is arranged over the lens, so that the observer need not place his eye directly above.—*June 2nd*, 1921.

SWITCHGEAR.

163,907. May 12th, 1920.—REGULATING SWITCHES, M. Mansell, 15–17, Cecil-court, Charing Cross-road, London, W.C. 2.

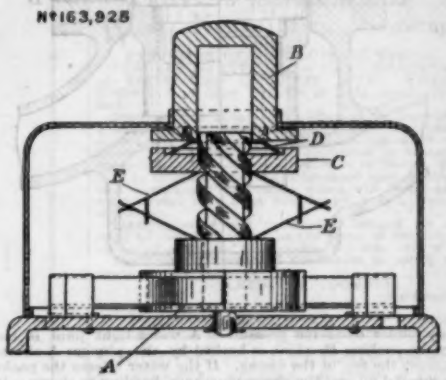
The object of this switch is to prevent the overloading of a



source of electricity supply which may have to furnish two separate variable circuits. The regulating switches of the two circuits are of normal pattern, as shown in the illustration. On the spindle of one switch there is a pinion A which engages with a rack B. A continuation of this rack meshes with another pinion on the other switch spindle. The connection between this pinion and spindle is, however, effected by a pin C working in a slot. Thus the left-hand switch can be moved, to increase the current in its circuit, without moving the right-hand switch, and the latter cannot then be advanced until the first switch has been brought back to reduce the current to any pre-determined amount, depending upon the length of the slot.—*June 2nd*, 1921.

163,925. June 19th, 1920.—PUSH-BUTTON SWITCHES, W. T. Ohrström, Ostgotagatan 27, Stockholm, Sweden.

In this switch an intermittent rotary movement in one direction is imparted to the contact disc A by the push button B. The button is prevented from rotating. It engages with the nut C by means of the spring clutch D. When the button,

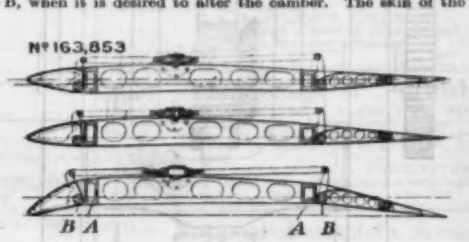


and with it the nut, is pushed down the screw and contact disc are rotated through one quarter of a turn. When the button is released the springs E E push the nut C up again, but as the clutch D is then released the nut is free to turn on the screw and does not turn the contact disc back again. The next pressure on the button repeats the movement.—*June 2nd*, 1921.

AERONAUTICS.

163,853. March 18th, 1920.—VARIABLE CAMBER WINGS, S. E. Saunders, Padmore House, Whippingham, Isle of Wight, and F. P. H. Beadle, Columbine-yard, Medina-road, East Cowes, Isle of Wight.

In these wings the central portion, between the two main spars A A, is rigid. The leading and trailing edges are bent, by means of cam-like extensions of the ribs keyed to the shafts B B, when it is desired to alter the camber. The skin of the

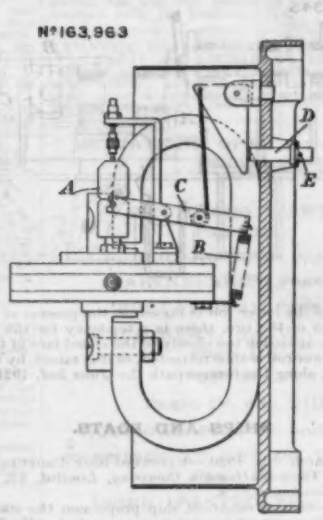


wing, which, it is said, is preferably of ply-wood sewn with copper wire, is free to slide over the cams. The edges of the skin are also free to slide, but at the front they are covered with a nose piece. The operation of the controlling mechanism needs no description.—*June 2nd*, 1921.

MEASURING AND TESTING INSTRUMENTS.

163,963. November 20th, 1919.—ELECTRICITY METERS, Chamberlain and Hookham, Limited, and S. James, 4, New Bartholomew-street, Birmingham.

This device is intended for sealing the mercury bath of mercury motor electricity meters when they are removed from their bases. The sealing device A is brought into action by the spring B pulling down on the lever C. When the meter



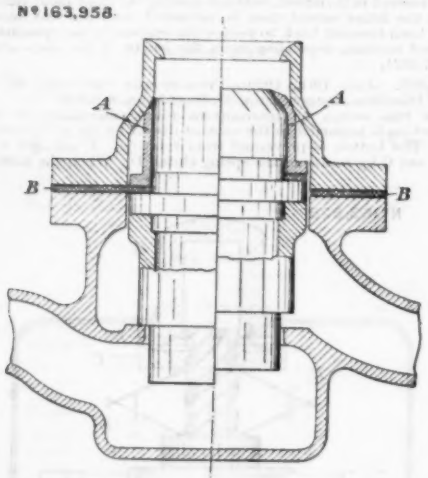
is mounted on its base the plunger D is pushed in and, by pressing on the bell-crank lever, puts the seal out of action. A split pin E may be put through the plunger to prevent accidental unsealing during transport of the meter.—*May 20th*, 1921.

163,958. June 10th, 1920.—WATER METERS, Hydrometer Breslauer Wassermesserfabrik, Aktiengesellschaft, 57–63, Siebenhufenstrasse, Breslau, Germany.

In order to protect this water meter from being burst by the

freezing of its contents, it is provided with a plunger which will yield under the pressure of the expanding ice. This plunger A is shown on the left of the drawing in the normal position, while on the right it is shown as it appears after having given

No 163,958



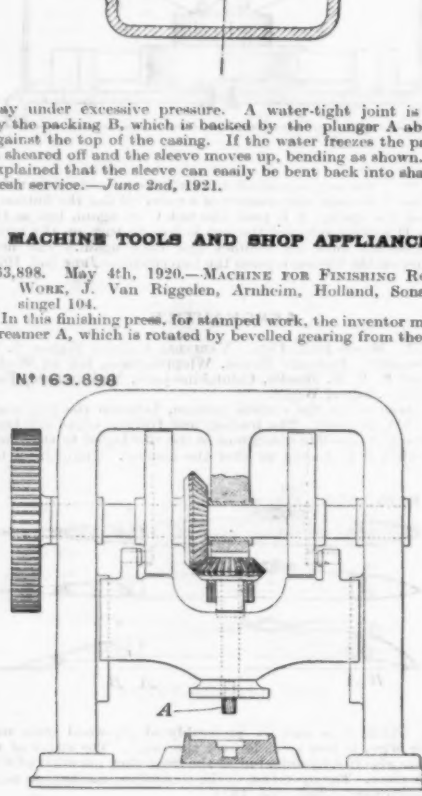
way under excessive pressure. A water-tight joint is made by the packing B, which is backed by the plunger A abutting against the top of the casing. If the water freezes the packing is sheared off and the sleeve moves up, bending as shown. It is explained that the sleeve can easily be bent back into shape for fresh service.—*June 2nd*, 1921.

MACHINE TOOLS AND SHOP APPLIANCES.

163,898. May 4th, 1920.—MACHINE FOR FINISHING ROLLED WORK, J. Van Riggelen, Arnheim, Holland, Sonsbeck-singel 104.

In this finishing press, for stamped work, the inventor mounts a reamer A, which is rotated by bevelled gearing from the main

No 163,898

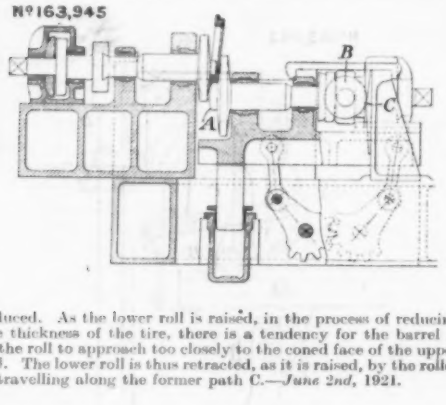


press shaft, with the idea of machining the central hole in the article at the same time as it is stamped.—*June 2nd*, 1921.

163,945. September 2nd, 1920.—TIRE-ROLLING MILLS, G. Baker, Greno House, Swinton, near Rotherham.

In this mill the working faces of the rolls are coned, at an angle of about 15 deg., in order to reduce the area of contact between the rolls and the tire, as compared with the area if the faces were flat. The result is that the end pressure on the roll shafts is

No 163,945



reduced. As the lower roll is raised, in the process of reducing the thickness of the tire, there is a tendency for the barrel A of the roll to approach too closely to the coned face of the upper roll. The lower roll is thus retracted, as it is raised, by the roller B travelling along the former path C.—*June 2nd*, 1921.

SHIPS AND BOATS.

163,838. March 9th, 1920.—ELECTRIC SHIP PROPULSION, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

In this system of electrical ship propulsion the stator A of the alternating-current generator is connected with the stator B of the motor through a set of phase-reversing switches as shown. The rotor of the motor has two windings—see Fig. 2. One winding C is of the high-resistance squirrel-cage type. The other D is a low resistance, definite winding, arranged below the squirrel cage in half the slots. The slip rings of this winding can be short-circuited by the switch E. The exciter is shown at F. In normal running the exciting current traverses both rotors in series. When it is required to reverse the motor, the exciting current is cut off and the phase-reversing switches changed over. The switch E is then closed, with the result that the winding D is short-circuited and the whole of the exciting current is diverted to the generator. When the motor

No 163,838 Fig. 1.

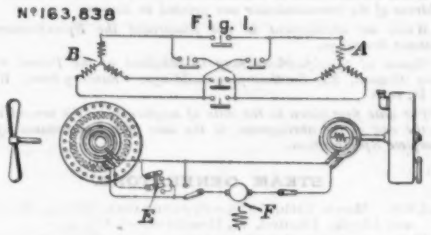
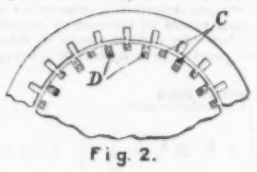


Fig. 2.



has come up to speed again, in the reverse direction, the switch E is re-opened.—*June 2nd*, 1921.

CRUSHING AND GRINDING.

163,856. March 19th, 1920.—BALL MILLS, A. M. Read, First Avenue and Big Four Railroad, Columbus, Ohio.

This ball mill is divided into a series of compartments by means of perforated partitions. The perforations become finer

No 163,856

as the outlet is approached. The material to be ground moves along, under the action of gravity, on account of the conical shape of the mill casing.—*June 2nd*, 1921.

MISCELLANEOUS.

163,868. March 29th, 1920.—PICKLING SOLUTION FOR IRON, The Rustproofing Syndicate, Limited, 15, Dean's-yard, Westminster, London, S.W. 1, and T. F. Newman, 2, Anerley-park, London, S.E. 20.

The object of this invention is to provide a pickling bath adapted to remove scale from iron or steel articles caused by rapid oxidisation during the cooling period after a heating operation. A suitable bath consists of 38 lb. of sulphate of iron dissolved in 300 gals. of water, the resulting solution then having added to it 112 lb. of sulphuric acid of a specific gravity of 1.84, and lastly 4 lb. of sulphate of zinc being added. If, to accelerate the scale-removing action, hydrochloric acid or nitric acid or both are added, suitable quantities are 20 lb. hydrochloric acid with 12 lb. nitric acid or 16 lb. nitric acid.—*June 2nd*, 1921.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. E. C. BOWDEN-SMITH, M.I. Mech. E., has removed his practice to 17, Victoria-street, Westminster, S.W. 1.

MR. ROBERT D. STEWART has changed his address from 61, Mansell-street, Aldgate, London, E. 1, to 12, Marsh Gate-lane, Stratford, E. 15 (near Bow Bridge).

THE Ministry of Communications of China, which controls all the Chinese Railways, has appointed Messrs. C. P. Sandberg and Partners, of 40, Grosvenor-gardens, London, S.W. 1, its honorary technical advisers.

TILGHMAN'S PATENT SAND BLAST COMPANY, Limited, and Geo. Richards and Co., Limited, of Broadheath, near Manchester, have changed the address of their London office from 33, Tothill-street, to 17, Grosvenor-gardens, London, S.W. 1.

MR. REGINALD BROWN, M. Inst. C.E., M.I. Mech. E., F.S.I., &c., now Chief Production Officer, Housing Department, Ministry of Health, announces that he is shortly resigning that position for the purpose of entering upon a consulting practice at 39, Victoria-street, Westminster.

ROBERT STEPHENSON AND CO., Limited, of Darlington, ask us to state that the address of their London office is now 17, Victoria-street, Westminster, S.W. The telephone number and telegraphic address remain as before, namely:—Telegrams, "Altiscope, Victoria," and telephone, Victoria 650.

SUTCLIFFE BROTHERS, Godley, near Manchester, inform us that they have converted their business of boiler and pipe covering manufacturers and contractors into a private limited liability company. The *personnel* of the management will continue as before. The name of the company will now be Sutcliffe Brothers and Bryce, Limited.

SIR W. G. ARMSTRONG, WHITWORTH AND CO., Limited, have secured the services of Mr. R. P. Tod, M.I. Mech. E., in connection with their hydro-electric work. Mr. Tod has been at the British Aluminium Company's works at Kinlochleven since 1907, where he was originally in charge of the erection of the pipe lines and turbines, and was, until recently, manager-in-chief of the whole of the undertaking at Kinlochleven. The civil engineering and contracting department of the firm has been moved from 8, Great George-street, to new offices at 51, Victoria-street, Westminster, S.W. 1 (telegraphic address, "Ubiquity, Vic. London," telephone numbers Victoria 1761 and 1762), to which it is requested that in future all communications intended for that department should be addressed. The hydro-electric section will remain at 8, Great George-street, Westminster.

Forthcoming Engagements.

FRIDAY, JULY 15TH.

INSTITUTION OF PRODUCTION ENGINEERS.—Institution of Mechanical Engineers, Storey's Gate, S.W. 1. Paper: "Production and the Engineer," by Mr. Max R. Lawrence. 7.30 p.m.

ROYAL INSTITUTION.—A general meeting of the members of the Royal Institution was held on Monday afternoon, the 4th inst., Sir James Reid, Vice-president, in the chair. Miss F. E. I. Smythe and Mrs. A. J. Webbe were elected members. The chairman announced that the Managers had re-elected Sir James Dewar Fullerian Professor of Chemistry.

AUTOMOBILE STANDARDISATION.—The Automobile Sub-committees of the British Engineering Standards Association are already making a start at actual standardisation work. Certain proposals for standardisation in connection with small fittings which were put forward some little time ago by the Association of British Motor Manufacturers, we learn, were considered at a meeting of Sub-committee 3, under the chairmanship of Mr. W. D. Williamson, on the morning of June 30th, that date having been chosen in order to take advantage of the presence in London of the representatives of the motor industry who were attending the meeting of the A.B.M.M. the same afternoon. The work will be divided into suitable sections and dealt with in accordance with the usual procedure of the Association.

THE CONVERSAZIONE OF THE INSTITUTION OF ELECTRICAL ENGINEERS.—The annual conversazione of the Institution of Electrical Engineers was held at the Natural History Museum, South Kensington, on Thursday evening of last week. The members and guests, numbering over 1600, were received by the President, Mr. Ll. B. Atkinson and Mrs. Atkinson. Many prominent engineers were among those present, including the following delegates of American engineering institutions:—Mr. Ambrose Swasey, Colonel A. S. Dwight, Mr. Charles F. Rand, Dr. Ira N. Hollis, Mr. John R. Freeman, Mr. Charles T. Main, Mr. Robert A. Cummings, Mr. Jesse M. Smith, Dr. F. B. Jewett, and Mr. William Kelly. During the evening Mr. Ambrose Swasey made a speech in the Central Hall, and was followed by Dr. F. B. Jewett, who conveyed a message from the American Institute of Electrical Engineers to the Institution of Electrical Engineers.

ROYAL SOCIETY OF ARTS.—The one hundred and sixty-seventh annual general meeting of the Royal Society of Arts was held on Wednesday afternoon, June 29th, Mr. Alan A. Campbell Swinton, F.R.S., chairman of the Council, presiding. It was reported that H.R.H. the Prince of Wales had accepted the office of vice-patron of the Society. The patron is H.M. the King, and the president H.R.H. the Duke of Connaught. Medals have been awarded for the following papers read during the session:—Major-General the Right Hon. Lord Lovat, K.T., K.C.M.G., K.C.V.O., "Forestry"; Colonel Robert J. Stordy, D.S.O., "The Breeding of Sheep, Llamas and Alpacas in Peru, with a view to Supplying Improved Raw Material to the Textile Trades"; Mr. Andrew Francis Baillie, chief engineer, Technical Department, Anglo-Mexican Petroleum Company, "Oil-burning Methods in Various Parts of the World"; Dr. Wm. Cramp, M.I.E.E., "Pneumatic Elevators in Theory and Practice"; Sir Kenneth Weldon Goadby, K.B.E., "Immunity and Industrial Disease"; Mr. William Raitt, cellulose expert to the Government of India, "Paper Pulp Supplies from India"; the Hon. Sir George Curtis, K.C.S.I., "The Development of Bombay"; Mr. A. H. Ashbolt, Agent-General for Tasmania, "Industrial Development in Australia during and after the War"; Sir Charles H. Bedford, late chemical examiner to the Government of India, "Industrial (including Power) Alcohol." The number of candidates entering for the Society's examinations this year was a record, the total being 55,181. The new Council for 1921–22 was elected; and also 30 new Fellows, making a total of 285 for the year.

INDIAN TIMBERS AND PAPER MATERIALS.—Inquiries into the possibility of increasing the utilisation of Indian timbers in this country and of making use of Indian paper materials have been carried out in connection with the Indian Trade Inquiry undertaken by the Committee for India of the Imperial Institute, and the reports have just appeared in a volume published by John Murray under the title, "Reports on Timbers and Paper Materials," price 4s. Hitherto the exports of timber—other than teak—from India have been relatively small, owing chiefly to the existence of a large local demand. It is considered, however, that there would be an opening for an extended export trade to the United Kingdom in certain hardwoods, which would be of value for decorative and other purposes, and are at present little known in this country. The characters and uses of a number of such timbers are described. In the section on paper materials, a general statement is given as to the world's pulp and paper-making industry, special reference being made to the position in India. Details are included as to the possibility of utilising Indian bamboos and savannah grasses for paper making, and the opinion is expressed that in these two materials India possesses valuable resources which occur under circumstances not unfavourable for their commercial development. It is considered that the immediate aim in the development of an Indian paper pulp industry, which should receive every encouragement from the Government of India, should be to reduce, and finally to replace—as far as possible by Indian supplies—the large amount of pulp and paper imported into that country. It is believed that the replacement of imports by Indian produce would be quickly followed by a surplus production which would be available for export.

FIRE PREVENTION DURING THE WAR.—The red book, No. 230, just issued, is a short record of the British Fire Prevention Committee's activities during the war. On the outbreak of war the Committee's offer of scientific assistance was accepted by a great number of Government Departments. At the request of the War Office, the Committee surveyed various types of camps, about thirty-five in different commands being inspected, with the result that fresh regulations were drawn up to prevent destruction by fire. Over 2500 surveys were made, including hospitals, depôts, warehouses, factories, camps, &c. Warnings for the prevention of fire in thirty kinds of establishments were specially drawn up, and over half a million copies were issued. A large number of these warnings were translated into the native language of the particular troops concerned. Thus, Urdu and Punjabi for the Indian troops, Arabic for use in Egypt and Palestine, with French and Flemish for the main front. Even Braille type was employed for use in blind asylums and hospitals. The Ministry of Munitions adopted the Committee's recommendations in their notices, and the War Office repeated them in Army orders. At the Committee's large and thoroughly equipped testing station, some eighty important tests were undertaken at the instigation of the Government Research Department during a period of three years. Whilst the Government made a grant to cover the expenses incurred with these tests, the members of the Committee who supervised the carrying out of them did so in quite an honorary capacity. The organisation and administration of the Committee's war work were carried out by a sub-committee, of which the late Earl of Londesborough was chairman, and the members were Messrs. the late Edwin O. Sachs, F.R.S. (Ed.), Percy Collins, T. C. Gilson, Ellis Mareland, Oswald C. Wylson, and Major E. C. P. Monson.